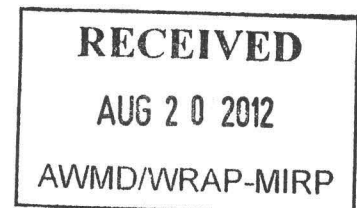




August 16, 2012
URS Project 16530531



Ms. Lynn Slugantz
Branch Chief
U.S. EPA Region 7
ARTD/RCAP
901 North 5th Street
Kansas City, Kansas 66101

RE: 2012 Annual Groundwater Monitoring Report
Former Sheller-Globe Facility at 3200 Main Street, Keokuk, Iowa

Dear Ms. Slugantz:

Enclosed is the 2012 Annual Groundwater Monitoring Report for the referenced site. This report is submitted on behalf of United Technologies Corporation (UTC) and Henniges Automotive (formerly Metzeler Automotive Profile Systems Iowa, Inc.), jointly referred to as "Respondents", in accordance with the Administrative Order on Consent RCRA-07-2007-0009 (the "Order").

As you will see in the report, the primary plume at the site remains stable, is contained on-site, and VOC concentrations are slowly decreasing. Given the stability of the groundwater flow directions and the plume, backed by 20 years of monitoring data, it is recommended to reduce the monitoring frequency at the site. Respondents recommend reducing the sampling frequency to years 3 and 5 over the next five years.

Please contact Bryan Kielbania at UTC if you have any questions or comments. He can be reached at (860) 728-6503.

Very truly yours,
URS Corporation

David A. Dods
Project Manager

Charles L. Arthur
Project Scientist

Enclosure

cc: Bryan Kielbania (UTC)
Joe Gregg, Esq. (Eastman and Smith)
Shawn McAfee (Henniges Automotive)
Dale Guariglia, Esq. (Bryan Cave LLP)
Mark Allen (SAS Environmental)
Chris Tedder (MACTEC)



2012 ANNUAL GROUNDWATER MONITORING REPORT

FORMER SELLER-GLOBE FACILITY
3200 MAIN STREET
KEOKUK, IOWA

Prepared for
United Technologies Corporation
Hartford, Connecticut
On behalf of Lear Corporation Automotive Systems

August 2012



URS Corporation
8300 College Blvd., Suite 200
Overland Park, KS 66210
913-344-1000
16530531



August 16, 2012
URS Project 16530531

Ms. Lynn Slugantz
Branch Chief
U.S. EPA Region 7
ARTD/RCAP
901 North 5th Street
Kansas City, Kansas 66101

RE: 2012 Annual Groundwater Monitoring Report
Former Sheller-Globe Facility at 3200 Main Street, Keokuk, Iowa

Dear Ms. Slugantz:

Enclosed is the 2012 Annual Groundwater Monitoring Report for the referenced site. This report is submitted on behalf of United Technologies Corporation (UTC) and Henniges Automotive (formerly Metzeler Automotive Profile Systems Iowa, Inc.), jointly referred to as "Respondents", in accordance with the Administrative Order on Consent RCRA-07-2007-0009 (the "Order").

As you will see in the report, the primary plume at the site remains stable, is contained on-site, and VOC concentrations are slowly decreasing. Given the stability of the groundwater flow directions and the plume, backed by 20 years of monitoring data, it is recommended to reduce the monitoring frequency at the site. Respondents recommend reducing the sampling frequency to years 3 and 5 over the next five years.

Please contact Bryan Kielbania at UTC if you have any questions or comments. He can be reached at (860) 728-6503.

Very truly yours,
URS Corporation

David A. Dods
Project Manager

Charles L. Arthur
Project Scientist

Enclosure

cc: Bryan Kielbania (UTC)
Joe Gregg, Esq. (Eastman and Smith)
Shawn McAfee (Henniges Automotive)
Dale Guariglia, Esq. (Bryan Cave LLP)
Mark Allen (SAS Environmental)
Chris Tedder (MACTEC)

URS Corporation
8300 College Blvd., Suite 200
Overland Park, KS 66210
Tel: 913.344.1000
Fax: 913.344.1011

RECEIVED

NOV 13 2012

AWMD/WRAP-MIRP

2012 ANNUAL GROUNDWATER MONITORING REPORT

FORMER SELLER-GLOBE FACILITY
3200 MAIN STREET
KEOKUK, IOWA

Prepared for
United Technologies Corporation
Hartford, Connecticut
On behalf of Lear Corporation Automotive Systems

August 2012



URS Corporation
8300 College Blvd., Suite 200
Overland Park, KS 66210
913-344-1000
16530531

TABLE OF CONTENTS

Section 1	Introduction.....	1-1
1.1	Purpose of the Annual Groundwater Monitoring Activities.....	1-1
1.2	Report Organization.....	1-1
1.3	Site Background.....	1-1
1.3.1	Contamination Source Areas	1-1
1.3.2	Site Remedies Selected.....	1-2
1.3.3	Site Topography and Soils.....	1-2
1.3.4	Previous Source Area Control Activities.....	1-4
Section 2	Summary of 2012 Groundwater Sampling Activities and Results.....	2-1
2.1	Groundwater Elevations and Flow Directions.....	2-1
2.2	Groundwater Sampling Methods.....	2-1
2.3	Laboratory Analysis and Data Review Activities	2-2
2.4	2012 Annual Groundwater Monitoring Results	2-3
2.4.1	Source Area Wells	2-4
2.4.2	Primary Plume Wells.....	2-5
2.4.3	Sentinel and Property Line Wells	2-6
2.5	Natural Attenuation Evaluation	2-7
2.5.1	Natural Attenuation Mechanisms	2-8
2.5.2	Biodegradation of Volatile Organic Constituents.....	2-8
2.5.3	Behavior of VOC Plumes	2-11
2.5.4	Evidence Required to Demonstrate Natural Attenuation	2-12
2.6	Site-Specific Natural Attenuation Evaluation	2-12
2.6.1	Plume Dimensions and Contaminant Mass/Concentration Trends	2-12
2.6.2	Geochemical Indicators of Natural Attenuation	2-13
2.7	References.....	2-16
Section 3	Conclusions and Recommendations.....	3-1

Tables

Table 1	June 18, 2012 Water Levels and Groundwater Elevations
Table 2	Monitoring Well and Piezometer Construction Details
Table 3	Analytical Results for Equipment and Trip Blanks
Table 4	Analytical Results for Shallow Wells
Table 5	Analytical Results for Till Wells
Table 6	Analytical Results for Sentinel and Property Line Wells

TABLE OF CONTENTS

Appendices

Appendix A	Annual Groundwater Sample Collection Field Sheets
Appendix B	QA/QC Review Summary
Appendix C	Trend Charts and Mann-Kendall Trend Analysis Worksheets
Appendix D	CD with Laboratory Analytical Data Reports and Report Drawings
	<u>Analytical Data Reports</u>
	Accutest Job Number TC10967
	Accutest Job Number TC10984
	Accutest Job Number TC11086
	Accutest Job Number TC11103
	Accutest Job Number TC11159
	<u>Drawings</u>
	Cover Property Line and Facility Layout
	Drawing 1 Fill Groundwater Elevation Contour Map – June 2012
	Drawing 2 Till Groundwater Elevation Contour Map – June 2012
	Drawing 3 Volatile Organic Constituents in Shallow Groundwater – June 2012
	Drawing 4 Volatile Organic Constituents in Deep Groundwater – June 2012
	Drawing 5 Total Non-Chlorinated VOCs in Groundwater – June 2012
	Drawing 6 Total Non-Chlorinated VOCs in Groundwater – June 2011
	Drawing 7 Total Chlorinated VOCs in Groundwater – June 2012
	Drawing 8 Total Chlorinated VOCs in Groundwater – June 2011
	Drawing 9 Tetrachloroethylene in Groundwater – June 2012
	Drawing 10 Trichloroethene in Groundwater – June 2012
	Drawing 11 cis-1,2-Dichloroethene in Groundwater – June 2012
	Drawing 12 Methylene Chloride in Groundwater – June 2012
	Drawing 13 Vinyl Chloride in Groundwater – June 2012
	Drawing 14 Total BTEX in Groundwater – June 2012
	Drawing 15 Cross Section A-A', Plume Centerline Wells – June 2012
	Drawing 16 Monitored Natural Attenuation Parameters – June 2012
Appendix E	Plume Attenuation/Distance Calculations

This report presents the results of the 2012 annual groundwater monitoring event performed during the week of June 18, 2012 at the former Sheller-Globe facility at 3200 Main Street in Keokuk, Iowa. The annual groundwater monitoring activities are performed to:

1. Monitor natural attenuation processes at the site and verify that the primary volatile organic compound (VOC) plume in the area of monitoring well clusters MW-10 and MW-13 continues to remain stable and/or decrease over time.
2. Confirm that contamination is not migrating off-site.
3. Continue to monitor how groundwater conditions subsequent to the source removal soil excavation activity conducted in 2007.

The findings from the 2012 sampling event include the following:

- Since the source removal in 2007, the primary VOC plume located in the Employee Parking Lot in the vicinity of the MW-10 and MW-13 well clusters remains stable to slightly decreasing in concentrations.
- VOC concentrations in sentinel well clusters (MW-17 and MW-23) and the property line wells (MW-19 and MW-20) remain below maximum contaminant levels (MCLs).
- Groundwater flow directions continue to remain consistent with historic patterns. Topographic and hydrogeologic conditions limit off-site migration of the VOC plume in the area of wells MW-10 and MW-13. The plume remains contained on-site.
- The primary VOCs in the parking lot plume continue to be methylene chloride (MC), trichloroethylene (TCE), and tetrachloroethylene (PCE). Benzene, toluene, ethyl benzene and xylene (BTEX) constituents in that area have been largely reduced due to the process related to the natural degradation of the chlorinated VOCs.
- The most significant indicators of natural attenuation at this site continue to be the presence of degradation daughter compounds. Zones of anoxic and reducing conditions which are necessary for reductive dechlorination to take place are slightly smaller than in previous years but remain present in the vicinity of the MW-10 and MW-13 well clusters.
- Since most of the BTEX compounds have been exhausted as part of the natural degradation of the chlorinated VOCs, the primary organic carbon source remaining, that may continue to support reductive dechlorination, appears to be MC. As a result, degradation rates may be slower in the future, but the chlorinated VOC plume continues to be stable and contained on-site.

The stability of the groundwater flow directions and the plume, backed by 20 years of monitoring data should warrant a reduced monitoring frequency at this site. It is recommended to reduce the sampling frequency to years 3 and 5 over the next five years.

1.1 PURPOSE OF THE ANNUAL GROUNDWATER MONITORING ACTIVITIES

This report presents the results of the 2012 annual groundwater monitoring event performed during the week of June 18, 2012 at the former Sheller-Globe facility at 3200 Main Street in Keokuk, Iowa. The corrective measures required for the site were documented in the Final Remedy Decision (EPA, September 22, 2006), and the Administrative Order on Consent signed July 3, 2007. The corrective measures selected by the Environmental Protection Agency (EPA) included excavation of shallow VOC-contaminated soils in the area of the former underground solvent tanks (a source removal), institutional controls, and Monitored Natural Attenuation (MNA) for groundwater. The source removal soil excavation activities were conducted in July 2007.

The annual groundwater monitoring activities are performed to:

1. Monitor groundwater conditions subsequent to the source removal soil excavation activity conducted in 2007.
2. Monitor natural attenuation processes at the site and verify that the primary VOC plume in the area of monitoring well clusters MW-10 and MW-13 continues to remain stable and/or decrease over time.
3. Confirm that contamination is not migrating off-site.

1.2 REPORT ORGANIZATION

Section 1.3 provides site background information and the purpose of the groundwater monitoring program.

Section 2.0 presents a summary of the groundwater sampling activities and results for the 2012 annual event, including an evaluation the natural attenuation monitoring results.

Section 3.0 presents results and conclusions.

The Appendices contain copies of field data sheets, data validation notes, statistical calculations, trend charts, plume attenuation calculations, as well as portable document format (PDF) copies of the report drawings and laboratory reports.

1.3 SITE BACKGROUND

This section summarizes background information for the site and repeats information that was first presented in the 2007 report.

1.3.1 Contamination Source Areas

The facility is located at 3200 Main Street in Keokuk, Iowa and has been utilized for the manufacture of rubber and foam rubber products since 1914. The site layout is shown on the cover drawing included in Appendix D. The site history has been documented in previous reports for the site. Former operations at the facility resulted in the release of VOCs to soil and groundwater in a limited area of the facility. A number of environmental investigations have been conducted to evaluate the degree and extent of contamination.

The primary source of soil and groundwater contamination was five underground solvent product tanks formerly located adjacent to the east side of the Chemical Mixing Building. The five tanks were removed in October 1989. In addition to the underground storage tanks, several secondary source areas were identified. Those included:

- An underground pipeline that connected the former solvent product tanks to the main facility;
- A former underground gasoline tank located just northeast of the Chemical Mixing Building;
- A former hazardous waste drum storage area (the Old Hazardous Waste Storage Area); located just east and south of the Chemical Mixing Building; and
- A former Chemical Mixing Building that was reportedly located in the area between monitoring wells MW-12 and MW-20.

Constituents of Concern (COCs) at the site include non-chlorinated and chlorinated solvents, the most prevalent of which are toluene, ethyl benzene, xylenes, TCE, PCE, and MC. A variety of other VOCs have been detected at the site in lesser concentrations.

1.3.2 Site Remedies Selected

The soils excavation conducted in July 2007 served as a source area removal action to help facilitate the groundwater remedy. The groundwater remedy selected for the site includes institutional controls and MNA.

1.3.3 Site Topography and Soils

The facility is situated approximately 1.4 miles west of the Mississippi River in an uplands area of the Mississippi River Valley. The topography of the uplands area generally consists of relatively narrow, flat to gently rolling hilltops, bordered by moderate to steep drainage side slopes. Ephemeral tributaries leading from the hilltop areas with moderately to steeply sloping sides are common. On the facility property, ground surface elevations range from approximately 660 feet above mean sea level (MSL) near Main Street to approximately 600 feet above MSL in the western portion of the property near Soap Creek. The majority of the facility buildings are at an approximate elevation of 640 feet above MSL.

The topographic high in the vicinity of the source areas is located, in general, in the area between the southwest side of the main facility building and the Chemical Mixing Building. This topographic high was artificially produced with fill material. This fill material, historically referred to as the "plant area fill," generally consisted of firm to stiff, medium plastic, silty clay with varying amounts of sand, gravel, brick, rubber, and debris. The plant area fill was thinnest near the main facility building and thickened towards the Employee Parking Lot. In the primary source area, the plant area fill was about eight to twelve feet thick. To the south and west of the Chemical Mixing Building, the plant area fill material rapidly sloped downward and ends near the edge of the Employee Parking Lot. Groundwater levels within the plant area fill historically ranged from four to ten feet below ground surface.

Plant area fill material was excavated during the source removal activities conducted in July 2007. The area that was excavated was located to the south and east of the Chemical Mix Building, generally along the embankment between monitoring wells MW-6A/6B, MW-2R, and MW-10A/10B. This area is shown on the report drawings (Appendix D). At the time of

excavation, it was observed that groundwater appeared to be located in isolated layers or lenses of more permeable fill material that occurred within the reworked native soils. Based on the location of water encountered, odors, and staining, the COCs appeared to occur primarily in those layers or pockets of more permeable material, rather than distributed uniformly throughout the plant area fill.

The excavation was backfilled with gravel and capped with a clay soil cover on the side slope behind the retaining wall and concrete driveway on the upper portion by the Chemical Mix Building. Shallow groundwater from the fill material layers or lenses now seeps into the gravel fill zone behind the retaining wall.

A dewatering pump is installed in the excavation backfill. The pump is activated by a float sensor and removes water from the backfill on a periodic basis to keep the backfill dewatered. Removed water is treated through two 1,000-pound liquid phase granular activated carbon (GAC) units to remove VOCs in the water. The treated water is tested and discharged to the Keokuk Publically Owned Treatment Works (POTW). Samples are collected on a semiannual basis to monitor performance of the GAC system. Those results are reported to the EPA in quarterly progress reports.

A topographic low is located within the center of the Employee Parking Lot. This area was formerly a southeast-northwest trending natural drainage that was filled in. The fill material within the Employee Parking Lot area and the drainage is referred to as the "engineered fill". In the center of the drainage, the engineered fill appears to be seven to eight feet thick. The exact source of the engineered fill is not known although it appears to be reworked glacial till. The engineered fill generally consists of soft to firm, yellowish-brown to olive-brown (with some gray mottling), low plastic, silty clay with some sand and gravel. Groundwater levels in the engineered fill typically range from one to three feet below ground surface, indicating that the majority of engineered fill is saturated.

Underlying the plant area fill and engineered fill is glacial till consisting of oxidized, firm to stiff, yellowish-brown to light-brown (with gray mottling), medium to highly plastic clay. Occasional fractures and thin discontinuous sand zones have been observed in the till. At elevations below 591 to 598 MSL, the oxidized till starts to become unoxidized, becoming hard and dark gray with almost no fractures. Stiff brown native clay glacial till was observed beneath the plant area fill material during the July 2007 excavation activities.

Groundwater flow in the fill and glacial till at the facility is generally a subdued reflection of the topography. Groundwater flows from the topographic high near the Chemical Mixing Building and the main facility building in a southwesterly direction towards the former northwest-southeast trending drainage in the Employee Parking Lot then trends to the northwest towards the topographically lower area represented by the Cooling Pond. Historical groundwater elevations indicate that a consistent upward gradient is present in the MW-17 well cluster located near the pond.

Estimates of hydraulic conductivity based on slug tests performed in a number of wells screened in the oxidized glacial till ranged from 1.9×10^{-5} centimeters per second (cm/s) to 5.6×10^{-5} cm/s with an average of 3.3×10^{-5} cm/s indicating that the glacial till yields little water. In addition to the slug tests, a simple, short-term pump test was performed in MW-10, which is screened in the oxidized glacial till from 19.4 feet to 29.4 feet below ground surface. The 4-inch diameter well was pumped dry in approximately 69 minutes after 34 gallons were removed at a

pumping rate of 0.5 gallons per minute. Based on the pre-test water level, it was calculated that approximately 29.5 gallons were removed from the casing and filter pack while only 4.5 gallons were removed from the glacial till. The pump test results also confirmed that the glacial till yields little water. During historic groundwater monitoring events, drawdown of water levels at pumping rates of 0.05 gallons per minute (200 milliliters per minute [ml/min]) or less were commonly observed for the majority of the wells. These observations indicate that the discontinuous sand lenses and occasional fractures are not transmitting a large volume of water through the till and fill. The slug and pump test results, along with the observed drawdown of water levels at very low flow rates, indicate that the fill and glacial till are not capable of providing a sufficient volume of water to be used as a potable water source.

1.3.4 Previous Source Area Control Activities

In an effort to remove VOCs from source area soils in the vicinity of the Chemical Mixing Building, a soil vapor extraction (SVE) and vacuum groundwater recovery (VGR) system was installed and operated from February 25, 1999 to July 29, 2002. The SVE/VGR system was installed and operated as an interim measures action under the 1990 Consent Order. The system was located in the area around the east, north, and west sides of the Chemical Mixing Building. The VGR component of the system dewatered the fill in order to increase the thickness of the vadose zone available for treatment by the SVE component of the system. Through July 29, 2002, the SVE/VGR system removed 4,252 pounds of target VOC compounds and 12,851 pounds of total VOCs. The SVE/VGR operation was terminated in July 2002 after an evaluation of system removal rates indicated that the system had reached the limits of its effectiveness.

SECTION TWO**Groundwater Activities And Results****2.1 GROUNDWATER ELEVATIONS AND FLOW DIRECTIONS**

Groundwater levels were measured in the fill and glacial till monitoring wells on June 18, 2012. Contour maps for the shallow fill zones and the deeper till zone are shown in Drawings 1 and 2, respectively (Appendix D). Groundwater levels and elevations are presented in Table 1. Monitoring well and piezometer construction details are presented in Table 2.

Groundwater flow directions in both the fill and the glacial till in June 2012 remain consistent with those observed during past events. Both elevations and contour patterns have remained very consistent over the years.

Groundwater flow in both zones generally follows the topography with flow from the topographic high near the main facility building towards the topographic low in the center of the Employee Parking Lot. The topographic low is a former natural drainage, which was filled in during construction on the Employee Parking Lot. The northwest trending stormwater line marks the approximate location of the topographic low. Topographically higher areas to the south and west of the former drainage direct groundwater flow towards the topographic low in the Employee Parking Lot. Groundwater flows from the vicinity of the topographic low within the Employee Parking Lot downgradient towards the Cooling Pond.

Vertical gradients vary depending on location at the facility. Historically, there has been a downward gradient from the fill to the glacial till in the topographically higher area between the main facility building and the Chemical Mixing Building. In 2012, a downward gradient was observed in well cluster MW-6.

In the Employee Parking Lot, vertical gradients were minor. In 2012, slight upward vertical gradients were observed at the MW-10, MW-13, and MW-17 well clusters, while a slight downward gradient was observed in well cluster MW-23.

2.2 GROUNDWATER SAMPLING METHODS

The following monitoring wells were sampled during the 2012 annual event:

- Source area wells MW-1; MW-2R; MW-3; MW-6A, plus MW-7 located north of the Chemical Mix Building
- Primary plume wells MW-10; MW-10A; MW-13; MW-13A, MW-13B
- Downgradient and sentinel wells: MW-16; MW-17A; MW-17B; MW-23A; MW-23B
- Property line wells: MW-19; MW-20

Monitoring well purging and sampling was performed in general accordance with the United States Army Corps of Engineers (USACE) standard operating procedure (SOP) for low-flow groundwater sampling per the Corrective Measures Implementation Work Plan (URS, May 2006). The monitoring wells were purged using a submersible pump with inlets placed between the midpoint and bottom of the screened interval of the well. The monitoring wells were purged at rates ranging from approximately 50 to 300 ml/min.

Water quality parameters consisting of dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, conductivity, pH, and turbidity were measured approximately every five

SECTION TWO**Groundwater Activities And Results**

minutes. Groundwater samples were collected after the parameters and water levels stabilized. For wells in which parameters did not stabilize, sampling was performed following the low recovery sampling procedure in the USACE SOP. Sample collection field sheets are included in Appendix A.

The samples were placed in an ice-filled cooler after sample collection. The sample cooler was shipped to Accutest Laboratories, Inc. (Accutest) in Houston, Texas under standard chain-of-custody protocol, consistent with historic practices.

2.3 LABORATORY ANALYSIS AND DATA REVIEW ACTIVITIES

Groundwater samples were analyzed by Accutest for VOCs and natural attenuation indicator parameters. Analytes and analytical methods used include:

- VOCs – Method 8260B
- Dissolved Gases (Methane, Ethane, and Ethene) – Robert S. Kerr (RSK) 175
- Dissolved Iron and Manganese – Method 6010B
- Total Organic Carbon (TOC) – Method 9060
- Chloride and Sulfate – Method 300.0A
- Total Sulfide – Method 353.2
- Nitrate – Method 353.2
- Nitrite – Method 354.1
- Alkalinity – Method 310.1

The data were independently reviewed by a URS chemist and judged acceptable for use with some qualifiers as described below. The data review summary is included in Appendix B. VOC and geochemical data for the 2012 annual event is presented in Tables 3, 4, 5, and 6. Electronic copies of the laboratory reports are included on a compact disk (CD) located in Appendix D.

All laboratory data were validated for compliance with the established quality control (QC) criteria based on the QC results provided by the laboratory. The data validation was performed in accordance with the review criteria detailed in the Quality Assurance Project Plan (QAPP), using a process that generally follows that outlined in National Functional Guidelines for Laboratory Data Review, Organics and Inorganics (USEPA 2008, 2004). These guidelines provided the basis for determining whether data should be qualified. Following completion of the initial review, the data validation reports were reviewed by a senior chemist for concurrence.

Samples were analyzed to achieve the lowest possible reporting limits within the constraints of the method. In some cases, the samples were diluted due to elevated concentrations of analytes exceeding the calibration range of the instrument. For diluted samples, the reporting limits were adjusted relative to the dilution applied.

Trace level detections, reported between the method detection limit (MDL) and the laboratory reporting limit (RL), have been qualified as estimated (J).

SECTION TWO**Groundwater Activities And Results**

Three equipment blank samples and four trip blank samples were collected during the sampling event to evaluate the potential for cross-contamination of the groundwater samples. There were no detections in any of these seven samples.

Overall, the sampling and analytical systems quality met criteria set forth in the QAPP. The data are considered usable without qualification with the exception of the following. Field duplicate samples were collected for MW-13 and MW-17B. Some analyte results were outside the field duplicate relative percent difference recovery and have been qualified as estimated (J).

2.4 2012 ANNUAL GROUNDWATER MONITORING RESULTS

Monitoring results are presented in a number of fashions consistent with past reports. They include the following:

Complete monitoring results from June 2012 are presented by well in Tables 3, 4, 5, and 6. Laboratory data reports with results for each well are included on the CD contained in Appendix D.

VOC results for shallow and deep wells are listed on Drawing 3 and Drawing 4, respectively. Total VOC isoconcentration lines for 2012 compared to 2011 are presented in the following drawings:

- Drawing 5 – Total Non-Chlorinated VOCs, June 2012
- Drawing 6 – Total Non-Chlorinated VOCs, April 2011
- Drawing 7 – Total Chlorinated VOCs, June 2012
- Drawing 8 – Total Chlorinated VOCs, April 2011

Isoconcentration plume maps for individual constituents are presented in the following drawings:

- Drawing 9 - PCE isoconcentration map
- Drawing 10 - TCE isoconcentration map
- Drawing 11 - cis-1,2-DCE isoconcentration map
- Drawing 12 - Methylene chloride isoconcentration map
- Drawing 13 - Vinyl chloride isoconcentration map
- Drawing 14 - Total BTEX isoconcentration map

A cross section through the plume centerline wells is presented in Drawing 15 and MNA parameters are presented in Drawing 16.

Concentration trend analysis was performed on PCE, TCE, cis-1,2-Dichloroethene (DCE), MC, vinyl chloride (VC), and total BTEX in monitoring network wells using the Mann-Kendall method, in general accordance with the EPA guidance document, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (EPA/600/R-98/128). Additionally, trend charts were prepared to visually depict concentration levels over time for the same constituents. The Mann-Kendall worksheets and trend charts are included in Appendix C.

SECTION TWO**Groundwater Activities And Results**

The individual constituent plume boundaries were calculated utilizing the Concentration vs. Distance Attenuation Rate Constant method outlined in the EPA issue paper *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies* (EPA/540/S-02/500). Those calculations are attached in Appendix E.

For discussion purposes, the monitoring wells have been divided into three groups based on their location as follows:

- Source area wells, plus MW-07 located north of the Chemical Mix Building;
- Primary plume wells, plus MW-13B in deep till and MW-16 outside centerline; and
- Sentinel and property line wells.

2.4.1 Source Area Wells

Source area wells include monitoring wells installed in fill materials in the vicinity of the former underground solvent product tanks and the Old Hazardous Waste Storage Area. The source area monitoring wells include the following:

- MW-1 (fill)
- MW-2R (fill)
- MW-3 (fill)
- MW-6A (fill)
- MW-7 (north of source area, till)

Well MW-2R is the replacement well for original well MW-2 that was removed during the 2007 excavation activities. For the purpose of trend analysis, MW-2R results were compared to historic results from MW-2.

Monitoring well MW-7, located north of the Chemical Mix Building is also included in this section, although it is not located in the immediate vicinity of the primary source area.

Prior to startup of the SVE system in February 1999, total VOC concentrations exceeded 200,000 micrograms/liter ($\mu\text{g/L}$) in monitoring wells MW-1 and MW-2, with lower, but still elevated VOC concentrations in MW-3 and MW-6A. However, after operation of the SVE/VGR system from February 1999 to July 2002, VOC concentrations dropped by orders of magnitude.

In June 2012, VOCs concentrations in source area wells MW-1, MW-2R, MW-3, and MW-6A remained orders of magnitude lower than historic levels and are generally consistent with 2011 results. Total chlorinated VOCs in MW-1 were $2.98 \mu\text{g/L}$ in 2012, as compared to $1.17 \mu\text{g/L}$ in 2011. Total non-chlorinated VOCs in MW-6A were $13.2 \mu\text{g/L}$ in 2012, as compared to $280 \mu\text{g/L}$ in 2011, and consisted totally of xylenes. It is believed that dewatering of the former excavation continues to draw residual VOCs from surrounding soils into the excavation zone and subsequent extraction by the pumping system.

Monitoring well MW-7 is a till well located north of the Chemical Mix Building. No specific VOC source area was known to exist in the vicinity of MW-7, but in previous monitoring events a variety of VOCs had sporadically been detected in this well. Overall, VOC concentrations in this well are one to two orders of magnitude lower than those found in the primary plume (wells

SECTION TWO**Groundwater Activities And Results**

MW-10 and MW-13). Mann-Kendall analyses (contained in Appendix C) suggest that VC and cis-DCE concentrations in well MW-7 are showing an increasing trend. However, the trend charts indicate that the results may be influenced by anomalously low results reported in 2008. MC concentrations are decreasing; PCE, TCE and Total BTEX are stable.

2.4.2 Primary Plume Wells

The primary plume wells include those monitoring wells that have been installed in the Employee Parking Lot below the embankment south and west of the Chemical Mixing Building. Some wells are installed in shallow fill material; others in the native glacial till. They include:

- MW-10A (primary plume, fill)
- MW-13A (primary plume, fill)
- MW-10 (primary plume, till)
- MW-13 (primary plume, till)
- MW-13B (beneath plume, deep till)
- MW-16 (outside primary plume, till)

Fill Wells

The primary plume fill wells include:

- MW-10A
- MW-13A

Wells MW-10A and MW-13A are shallow wells located in the Employee Parking Lot downgradient of the former underground solvent product tanks. Concentrations in the shallow zone remain orders of magnitude lower than those found in the deeper till zone (wells MW-10 and MW-13) and continue to show stable to decreasing concentration trends. Total VOC concentrations in MW-13A and MW-10A are shown in the table below.

Till Wells

The primary plume glacial till wells include

- MW-10
- MW-13

These wells are screened in the weathered glacial till zone located below the engineered fill material. Since April 2001, the highest VOC concentrations at the facility have been in MW-13 and MW-10. The highest VOC concentrations detected in these wells continues to be MC. TCE, PCE, and Cis-1,2-DCE concentrations are also elevated, but at concentrations an order of magnitude lower than MC.

SECTION TWO**Groundwater Activities And Results**

Total VOC concentrations in wells MW-10 and MW-13 are several orders of magnitude higher than those reported in the overlying fill wells (MW-10A and MW-13A) and the deeper unoxidized unweathered till well MW-13B, as shown on the following table. Thus, the primary zone of remaining VOC contaminates remains limited to the upper weathered oxidized till.

**Total VOC Concentrations (µg/L)
Plume Centerline Wells**

	MW-10A	MW-10	MW-13A	MW-13	MW-13B
May 2007	322	13,054	14	13,623	6.3
May 2008	234	3,935	5	11,062	4.1
May 2009	32	8,300	4.6	3,967	ND
April 2010	14.5	4,589	3.5	5,002	0.7
June 2011	8.4	6,182	9.9	8,139	1.0
June 2012	8.4	5,161	10.4	2,526	0.5

Total VOC concentrations in well MW-10 were within the concentration reported the previous two years. Trend analysis charts indicate stable to decreasing concentration trends in MW-10.

Total VOC concentrations in MW-13 were lower in 2012 than in 2011, and lower than all years since 2007. Trend analysis charts indicate a decreasing concentration trend in MW-13.

The results in both MW-10 and MW-13 are largely a function of the MC concentrations.

MW-13B is located adjacent to MW-13 and MW-13A and is screened in the deeper unoxidized unweathered till. Monitoring well MW-13B serves as a monitoring point in the deeper unweathered unoxidized till. In 2012, low level concentrations of TCE (0.45 µg/L) were detected in MW-13B.

Monitoring well MW-16 is a till well located downgradient of the MW-13 well cluster, on the opposite side of the low point and stormsewer line in the Employee Parking Lot. The VOC concentrations in MW-16 were below the RLs.

2.4.3 Sentinel and Property Line Wells

The sentinel wells include those monitoring wells that have been installed downgradient of the primary plume but upgradient of the Cooling Pond. Well clusters MW-17 and MW-23 serve as points to monitor for potential migration of VOCs towards the Cooling Pond. Each of the clusters has a monitoring well screened in the fill and underlying weathered glacial till.

Fill Wells

The sentinel fill wells include:

- MW-17A
- MW-23A

SECTION TWO**Groundwater Activities And Results**

Wells MW-17A and MW-23A are located in shallow fill material upgradient of the Cooling Pond and are directly downgradient of the primary plume located around MW-10 and MW-13. All VOC results were below the RLs in both wells. The statistical trend charts indicated increasing concentration trends for BTEX, but that is a function of the RL data being entered as the detection in the calculations.

Till Wells

The sentinel till wells include:

- MW-17B
- MW-23B

Wells MW-17B and MW-23B are located in the upper weathered till, upgradient of the Cooling Pond and are directly downgradient of the primary plume located around MW-10 and MW-13. In 2012, a low level concentration of VC (0.46 µg/L) was detected in MW-17B. All other VOC results were below the RLs in MW-17B and MW-23B. The statistical trend charts indicated increasing concentration trends for BTEX, but that is a function of the RL data being entered as the detection in the calculations.

Property Line Till Wells

The property line till wells include:

- MW-19
- MW-20

MW-19 and MW-20 serve as property line wells at the facility. Both wells are screened in the upper weathered till. MW-19 is located upgradient of the primary plume in a position to monitor the quality of groundwater flowing onto the site property at the Employee Parking Lot. Monitoring well MW-20 is located near the southwest corner of the facility building.

The VOC concentrations were below the RLs in MW-19 or MW-20. The statistical trend charts indicated increasing concentration trends for BTEX in MW-19, but that is a function of the RL data being entered as the detection in the calculations.

2.5 NATURAL ATTENUATION EVALUATION

This section of the report describes the major natural attenuation processes, and the purpose of the MNA monitoring parameters. It repeats background information first presented in the 2007 report. Section 2.6 reviews the June 2012 monitoring results for MNA trends.

The VOCs present at highest concentrations in groundwater at the site are PCE, TCE, and MC, all of which are chlorinated VOCs. The primary natural attenuation process at work appears to be biodegradation of chlorinated VOCs through reductive dechlorination. Groundwater samples collected from each of the monitoring wells were analyzed for the following geochemical parameters:

- Dissolved Gases (Methane, Ethane, and Ethene) – Robert S. Kerr (RSK) 175

SECTION TWO**Groundwater Activities And Results**

- Dissolved Iron and Manganese – Method 6010B
- TOC – Method 9060
- Chloride and Sulfate – Method 300.0A
- Total Sulfide – Method 353.2
- Nitrate – Method 353.2
- Nitrite – Method 354.1
- Alkalinity – Method 310.1

In addition, DO and ORP were measured in the field at the time of sample collection. Data used for the natural attenuation evaluation are shown on Drawing 16.

2.5.1 Natural Attenuation Mechanisms

The EPA refers to “monitored” natural attenuation as:

“the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a timeframe that is reasonable compared to that offered by other more active methods. The “natural attenuation processes” that are at work include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentrations of contaminants in soil or groundwater. These in-situ processes include biodegradation, dispersion, dilution, sorption, volatilization, radioactive decay, and chemical or biological stabilization, transformation, or destruction of contaminants” (EPA, 1999).

Natural attenuation of VOCs in groundwater may result from one or more attenuation mechanisms that can be classified as either destructive or non-destructive. Typically, the destructive mechanisms are the most important processes since they result in the elimination of a contaminant. Biodegradation typically is the most important of the destructive mechanisms although abiotic mechanisms such as hydrolysis may play an important role for some contaminants. Non-destructive mechanisms include sorption, dispersion/dilution, and volatilization.

2.5.2 Biodegradation of Volatile Organic Constituents

Numerous studies have shown the effectiveness of biodegradation in the breakdown of non-chlorinated volatile organic constituents such as BTEX as well as chlorinated VOCs such as PCE, TCE, trichloroethane (TCA), and carbon tetrachloride. Biodegradation can occur through four different mechanisms: electron donor reactions, electron acceptor reactions, fermentation, and cometabolism. Each mechanism is described below.

Electron Donor Reactions

Microorganisms use the carbon within organic compounds as a food source. As the microorganisms break down the organic compounds to obtain the carbon, electrons are lost from

SECTION TWO**Groundwater Activities And Results**

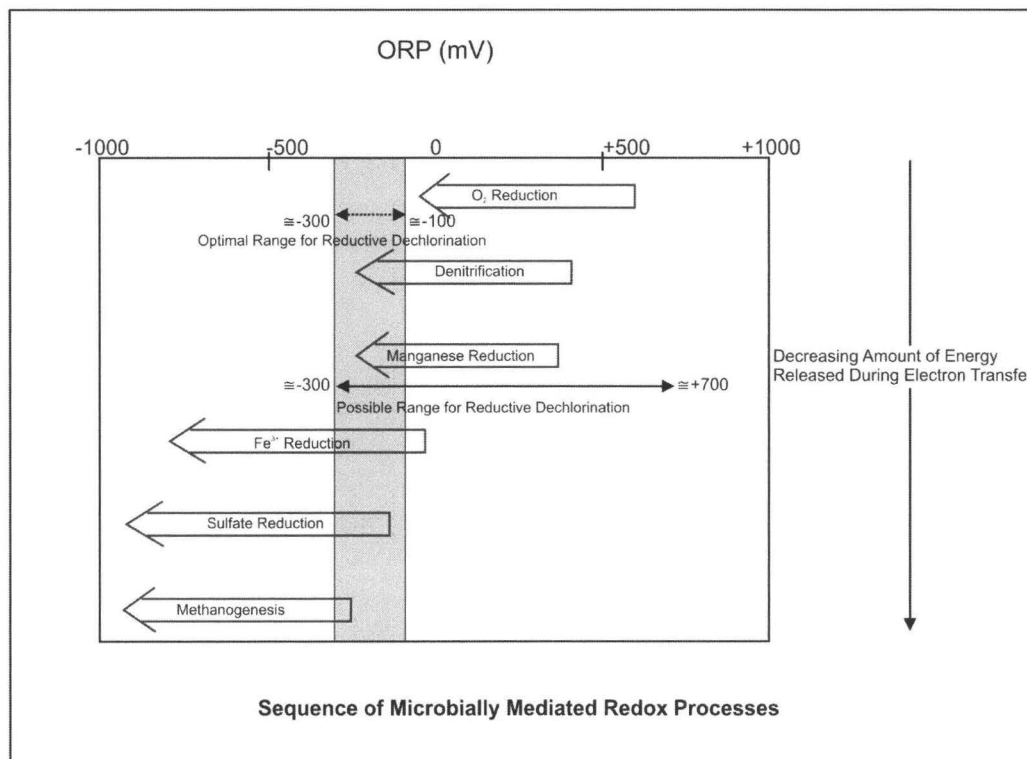
the organic compounds (electron donors) and transferred to electron acceptors through oxidation-reduction reactions. The electron donors are oxidized and lose electrons while the electron acceptors are reduced and gain electrons. The release of energy provided through the electron transfer is used by the microorganisms to sustain metabolic processes and growth. Organic compounds including naturally occurring carbon, non-chlorinated VOCs such as BTEX, and some less highly chlorinated VOCs such as MC and VC can be used as electron donors. However, the more highly chlorinated VOCs such as PCE and TCE are generally believed to be incapable of serving as electron donors.

Electron Acceptor Reactions

To complete the oxidation-reduction reactions, the electrons removed from the electron donors must be transferred to electron acceptors. The most common electron acceptors are dissolved oxygen, nitrate, manganese (Mn^{4+}), ferric iron (Fe^{3+}), sulfate, and carbon dioxide. Under aerobic conditions, dissolved oxygen is used by aerobic microorganisms as an electron acceptor. After the available dissolved oxygen is depleted and the environment becomes anaerobic, microorganisms will sequentially use nitrate, manganese (Mn^{4+}), ferric iron (Fe^{3+}), sulfate, and carbon dioxide as electron acceptors. As the electron acceptors are exhausted, the ORP decreases and the groundwater environment becomes more reducing. Under certain reducing conditions, chlorinated VOCs may be used as electron acceptors by halo-respiring microorganisms through a process called reductive dechlorination. During reductive dechlorination, a chlorine ion is removed from the VOC being reduced and is replaced with a free electron in the form of a hydrogen ion. Reductive dechlorination is the primary process through which most chlorinated VOCs are biodegraded. VOCs which may be biodegraded through their use as electron acceptors include common parent compounds such as PCE, TCE, TCA, and carbon tetrachloride as well as their breakdown products. The illustration presented below shows the typical ORP ranges where various electron acceptors are used and the possible and optimal ranges for reductive dechlorination,

SECTION TWO

Groundwater Activities And Results

**Fermentation**

Fermentation is a special type of oxidation-reduction reaction where the organic compound being degraded acts as both an electron acceptor and electron donor. Fermentation occurs in anaerobic environments and is typically a two step process. In the first step, organic compounds undergo fermentation to produce water, carbon dioxide, volatile fatty acids such as acetate, and most importantly, dissolved hydrogen. The carbon dioxide, dissolved hydrogen, and volatile fatty acids may then be used in the second fermentation step by methanogenic microorganisms to produce methane. Dissolved hydrogen produced by the first fermentation step may also be used by halorespiring microorganisms (the reductive dechlorinators) to degrade chlorinated VOCs. The presence of methane indicates a deeply reducing environment with dissolved hydrogen present that is favorable for breakdown of chlorinated VOCs through reductive dechlorination. Naturally occurring organic carbon, non-chlorinated VOCs such as BTEX, and some chlorinated VOCs such as MC can undergo fermentation to produce the dissolved hydrogen necessary for reductive dechlorination.

Cometabolism

Under cometabolism, chlorinated VOCs such as TCE may be indirectly degraded by enzymes fortuitously produced by microorganisms as they use non-chlorinated VOCs such as BTEX to meet their food and energy requirements. The microorganisms receive no direct benefit from the breakdown of the chlorinated VOCs. Cometabolic reactions are typically slow and are not usually a significant element in the biodegradation of VOCs.

SECTION TWO**Groundwater Activities And Results****2.5.3 Behavior of VOC Plumes**

Non-chlorinated and chlorinated VOC plumes may exhibit different behavior dependent on their specific environment. In general, non-chlorinated VOCs such as BTEX can be degraded by both aerobic and anaerobic microorganisms for which they act as a carbon source and electron donor. In most environments, there is generally a sufficient amount of electron acceptors present to complete the oxidation-reduction reactions necessary for effective biodegradation of non-chlorinated VOCs. This typically allows the non-chlorinated VOC plumes to stabilize or even decrease in size after relatively short periods of time. Conversely, with the exception of a few of the less chlorinated VOCs like MC and VC which can act as electron donors, most chlorinated VOCs undergoing biodegradation generally serve as electron acceptors. For most chlorinated VOCs to be effectively degraded there must be a sufficient source of electron donors being biodegraded to drive the groundwater environment to sufficiently reducing conditions. At many sites, the amount of electron donors present is not sufficient to promote complete degradation of the chlorinated VOCs. Thus, depending on the amount of electron donors and the type of chlorinated VOCs present, the behavior of chlorinated VOC plumes may exhibit three general types of behavior. The types of plume behavior are described below.

Type 1 Behavior

Type 1 Behavior occurs when the water-bearing unit has an electron donor consisting of anthropogenic (man-made) carbon such as BTEX which drives reductive dechlorination. This type of behavior can result in the rapid degradation of highly oxidized chlorinated VOCs like PCE and TCE. However, degradation rates decrease sequentially for the less oxidized chlorinated VOCs (i.e. VC degrades slower than 1,2-DCE, which degrades slower than TCE, etc.) This may result in the accumulation of breakdown products.

Type 2 Behavior

Type 2 behavior occurs when the water bearing unit has relatively high concentrations of naturally occurring organic carbon. The natural organic carbon serves as the electron donor which drives reductive dechlorination. Type 2 behavior reportedly results in slower degradation of the more chlorinated VOCs such as PCE and TCE, but under the right conditions, breakdown of these compounds may still occur rapidly.

Type 3 Behavior

Type 3 behavior occurs when the water bearing unit has low concentrations of native and/or anthropogenic carbon and has DO concentrations of greater than 1 milligram per liter (mg/L). Under these aerobic conditions, reductive dechlorination typically cannot occur. However, some biodegradation may occur through the oxidation of VC by aerobic microorganisms. Advection, dispersion/dilution, and sorption may play a more significant role in the natural attenuation of chlorinated VOCs in this environment.

SECTION TWO**Groundwater Activities And Results*****Mixed Behavior***

A single chlorinated VOC plume may exhibit some or all three types of behavior in different parts of a plume. For example, within the source area, Type 1 or Type 2 behavior may be occurring to promote degradation of the more chlorinated VOCs like PCE and TCE while downgradient Type 3 behavior may be occurring in which VC is being oxidized. This is the preferred scenario since the oxidation of VC to carbon dioxide occurs rapidly in the downgradient aerobic portion of the plume preventing accumulation of VC.

2.5.4 Evidence Required to Demonstrate Natural Attenuation

As stated in the Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (EPA, 1998), three lines of evidence may be used to evaluate whether natural attenuation is occurring. These lines of evidence include:

First Line of Evidence – Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentrations over time at appropriate monitoring or sampling points

Second Line of Evidence – Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels

Third Line of Evidence – Data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern (typically used to demonstrate biological degradation processes only)

The first and second lines of evidence are typically required to be proven in order to support a natural attenuation evaluation. Where the data are inadequate or inconclusive, the information supporting the third line of evidence may be required.

2.6 SITE-SPECIFIC NATURAL ATTENUATION EVALUATION

The source removal action was completed in July 2007. The June 2012 sampling was the fifth annual monitoring event following that removal. The primary plume extends from the source area through the MW-10 and MW-13 well clusters in the center of the plume, to the downgradient sentinel well clusters MW-17 and MW-23.

2.6.1 Plume Dimensions and Contaminant Mass/Concentration Trends

Drawings 5, 6, 7, and 8 present isoconcentration maps for total chlorinated and total non-chlorinated VOCs in the primary plume for June 2012 compared to June 2011. These drawings present overall dimensions of the plume in the shallow fill material zone and the upper till zone. The 2007 groundwater monitoring report included similar drawings for the years 2004, 2001, and 1991, which previously showed that the plume had been reduced at that point in time from original dimensions mapped in 1991.

A statistical method, known as the Mann-Kendall Test is used each year to evaluate plume stability based on concentration trends for individual constituents in individual wells. Those results were presented in Section 2.4, and the worksheets are contained in Appendix C.

SECTION TWO**Groundwater Activities And Results**

Graphical concentration vs. time charts for the primary VOCs in each well are also included in Appendix C.

Mapping the plume extent for individual constituents was begun in 2007. Similar drawings were prepared again from the June 2012 data (Drawings 9 to 14). The plume boundaries were calculated utilizing the Concentration vs. Distance Attenuation Rate Constant method outlined in the EPA issue paper *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies* (EPA/540/S-02/500).

The June 2012 monitoring results are generally consistent with the April 2011 concentrations. The results also suggest that the VOC concentrations in the center of the plume and plume boundaries have decreased overall since 2007. The results in well MW-10A (the first well downgradient from the excavation area) decreased markedly after the 2007 source removal.

2.6.2 Geochemical Indicators of Natural Attenuation

The most significant indicators of natural attenuation at this site are the long term decreases in primary contaminant concentrations coupled with the presence of degradation daughter compounds. Zones of anoxic and reducing conditions are present within the center of the plume. Since most of the BTEX compounds have been reduced due to the processes related to the natural degradation of the chlorinated VOCs, the primary organic carbon source that may support continuing reductive dechlorination appears to be MC.

Parent Compounds and Degradation Products

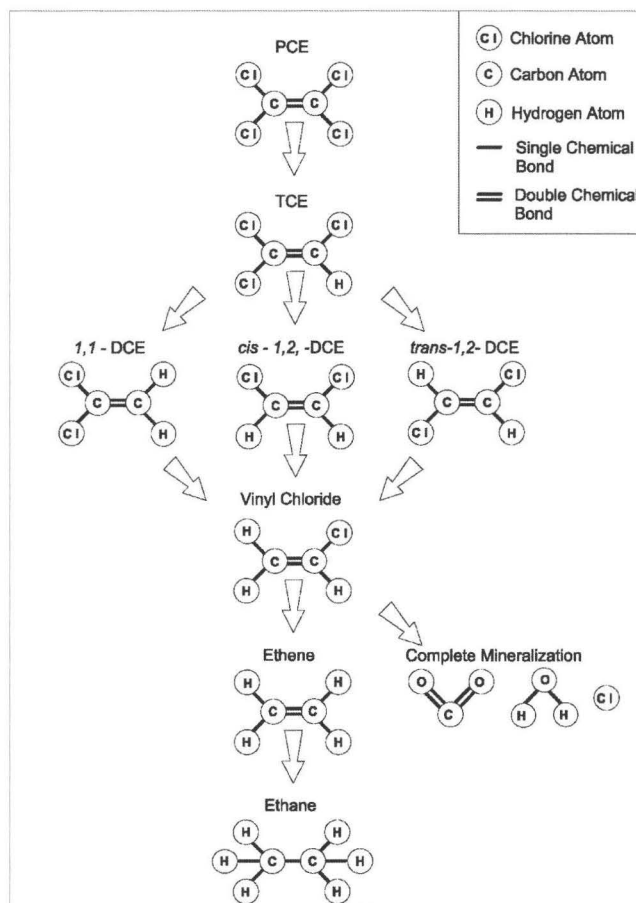
The primary non-chlorinated VOCs historically detected in groundwater at the Facility have been toluene, ethyl benzene, and xylenes. At most sites, non-chlorinated VOCs undergoing biodegradation are oxidized directly to carbon dioxide and water. These compounds were found in water removed from or the excavation backfill zone by the dewatering system, but concentrations decline significantly in the shallow and deeper monitoring wells immediately downgradient of that zone.

The primary chlorinated VOC parent compounds detected in groundwater at the site are MC, PCE, and TCE. PCE is the most chlorinated of the compounds. As PCE degrades through reductive dechlorination it is transformed into TCE. Through further reductive dechlorination, TCE is degraded to DCE then to VC, and finally to ethene and ethane. Of the three DCE isomers (1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE), reductive dechlorination produces greater concentrations of cis-1,2-DCE than of the other two isomers. In addition, the presence of VC also indicates that reductive dechlorination is occurring.

VC is typically not present as a primary contaminant since it is not used as a solvent and it exists as a gas at room temperature. For these reasons, the presence of cis-1,2-DCE and VC are strong indicators of the occurrence of reductive dechlorination. The sequential degradation of the chlorinated ethenes is illustrated below.

SECTION TWO

Groundwater Activities And Results



Reductive dechlorination of chlorinated ethenes (From EPA/600/R-98/128)

In June 2012, cis-1,2-DCE and low levels of VC remain present in wells MW-10 and MW-13, providing evidence of degradation products.

Presence and Distribution of Electron Donors

Biodegradation of non-chlorinated VOCs is dependent upon a sufficient supply of electron acceptors (e.g., DO, ferric iron, manganese, nitrate, and sulfate) for which there is generally a sufficient supply at most sites. Conversely, chlorinated VOCs are dependent upon electron donors (naturally occurring and anthropogenic carbon sources) to drive the environment to sufficiently reducing conditions favorable for reductive dechlorination.

BTEX is considered the primary carbon source and electron donor at many sites where these compounds are present in sufficient concentrations. According to EPA's method for preliminary screening for reductive dechlorination (EPA, 1998), BTEX concentrations exceeding 100 µg/l are sufficient to support reductive dechlorination although it may also occur at lower concentrations. Total xylene concentrations in shallow well MW-6A near the former excavation were 13.2 µg/L. Concentrations appear insufficient in the MW-10 and MW-13 well clusters to provide the required carbon source.

TOC is another general indicator of the amount of electron donors available. According to EPA's method for preliminary screening for reductive dechlorination, TOC concentrations

SECTION TWO**Groundwater Activities And Results**

greater than 20 mg/L generally indicate that there is a sufficient mass of electron donors to support reductive dechlorination although it may occur at lower concentrations. In June 2012, only MW-13A and MW-23A had TOC concentrations above that level.

Elevated concentrations of MC are present in wells MW-10 and MW-13, and it has the potential to serve as the primary electron donor after the consumption of the non-chlorinated compounds.

Presence of Electron Acceptors and Metabolic Byproducts

In addition to the electron donors, electron acceptors are required to complete microbially mediated oxidation-reduction reactions. Evaluation of the presence or absence and relative concentrations of the electron acceptors, as well as metabolic byproducts, provide indications of the types of microbially mediated reactions occurring. Groundwater in the zone extending from the 2007 excavation area to the MW-13 well cluster exhibits some reducing indicators such as low DO, and negative ORP.

DO is the first electron acceptor to be consumed, and anaerobic conditions are required to support reductive dechlorination (generally less than 0.5 mg/L is required). Reductive dechlorination may occur under a wide range of ORP ranging from approximately +700 to -300 milli-volts (mV). However, reductive dechlorination typically occurs at ORP values of less than +50 mV with concentrations less than -100 mV indicating that reductive dechlorination is likely.

DO and/or ORP results that could support reducing conditions were reported in source area wells MW-1, MW-2R, MW-6A, and MW-7; primary plume wells MW-13A, and MW-13B; downgradient wells MW-16, MW-17A, MW-17B, and MW-23A; and property line well MW-19. These wells had DO readings of less than 0.5 mg/L and ORP readings of less than 50 mV. Only MW-2R had an ORP reading of less than -100 mV.

After the available DO is depleted, nitrate may be used as an electron acceptor for the anaerobic biodegradation of chlorinated VOCs through the process of denitrification. Therefore, where denitrification is or has been occurring, nitrate concentrations tend to be lower than background concentrations. Consistent with previous results, nitrate levels remain generally low throughout the site and therefore evidence for denitrification is inconclusive.

Drawing 16 presents the MNA parameter results, and illustrates zones of the site that support reductive dechlorination. The reducing zones are based primarily on the presence of degradation products evaluated along with DO levels and redox conditions.

Following depletion of nitrate, manganese can be used as an electron acceptor to degrade non-chlorinated VOCs. In this process, manganese is reduced from Mn^{4+} to Mn^{2+} . Mn^{2+} is a dissolved form of manganese, and when present at concentrations greater than background levels, is indicative that microorganisms are using manganese as an electron acceptor. Dissolved manganese levels in the center of the plume range from approximately 2 to 7 mg/L in the MW-10 and MW-13 well clusters, compared to less than 1 mg/L in perimeter wells MW-20 and MW-19. The high end of the center plume range is slightly lower but consistent with the 2007 through 2011 results.

The next electron acceptor to be used following the depletion of nitrate and manganese (Mn^{4+}) is ferric iron (Fe^{3+}). When used as an electron acceptor, Fe^{3+} is reduced to form ferrous iron (Fe^{2+}) which occurs in dissolved form. Therefore, locations where high levels of dissolved iron are

SECTION TWO

Groundwater Activities And Results

present can be indicative of an iron-reducing environment. Dissolved iron levels in the shallow plume centerline wells MW-10A and MW-13A were 6.77 mg/L and 55.7 mg/L, compared to non-detect and 0.728 mg/L in perimeter wells MW-19 and MW-20.

Sulfate normally becomes the preferred electron acceptor after ferric iron is consumed. Under sulfate reducing conditions, sulfate is converted to sulfide. Therefore, sulfate concentrations may be expected to be lower where sulfate reducing conditions exist compared to background conditions. Sulfate and sulfide results at the site have not historically exhibited clear trends.

Methanogenic bacteria use dissolved hydrogen as an electron donor and carbon dioxide as an electron acceptor to meet metabolic requirements which results in the production of methane. The presence of methane indicates a deeply reducing environment with dissolved hydrogen present that is favorable for the reductive dechlorination of chlorinated VOCs. Consistent with past results, methane concentrations are elevated in the shallow zone of the center of the plume (MW-6A, MW-10A, MW-13A, and MW-23A) relative to perimeter wells.

According to EPA's method for preliminary screening for reductive dechlorination (EPA, 1998), ethene concentrations exceeding 10 µg/l indicate that VC is degrading to ethene through reductive dechlorination. According to EPA, 1998, ethane concentrations exceeding 100 µg/l indicates that ethene is being further reduced to ethane. Ethene and ethane levels were inconclusive in 2012.

During reductive dechlorination, chloride ions are removed from the chlorinated VOCs and replaced with hydrogen ions. Thus, concentrations of chloride exceeding background levels are expected in areas where reductive dechlorination is actively degrading chlorinated VOCs. Chloride results were inconsistent across the site in 2007 and potentially showed some indications of dechlorination in 2008. As in 2009 through 2011 concentrations were elevated in wells MW-6A, MW-13A, MW-16, and MW-23A relative to background wells MW-19 and MW-20.

MNA Summary

Natural attenuation parameters are presented on Drawing 16. The drawing also depicts zones within the plume exhibiting conditions that are conducive for reductive dechlorination. Overall, the reducing zone may be smaller than the previous year, but the middle of the plume in the vicinity of the MW-10 and MW-13 well clusters continues to exhibit reducing conditions.

2.7 REFERENCES

- URS Corporation. 2007 Annual Groundwater Monitoring Report, Former Sheller-Globe Facility, 3200 Main Street, Keokuk, Iowa, Revision 1. October 2007
- U.S. Environmental Protection Agency. Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies (EPA/540/S-02/500).
- U.S. Environmental Protection Agency. 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. September 1998.
- U.S. Environmental Protection Agency. 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Interim Final OSWER Directive 9200.4.17.

The general conclusions based on the results of the 2012 annual groundwater monitoring event are:

- The primary VOC plume located in the Employee Parking Lot in the vicinity of the MW-10 and MW-13 well clusters remains stable and slightly decreasing.
- VOC concentrations in sentinel well clusters (MW-17 and MW-23) and the property line wells (MW-19 and MW-20) remain below maximum contaminant levels (MCLs).
- Groundwater flow directions continue to remain consistent with historic patterns. Topographic and hydrogeologic conditions limit off-site migration of the VOC plume in the area of wells MW-10 and MW-13. The plume remains contained on-site.
- The primary VOCs in the parking lot plume continue to be methylene chloride (MC), trichloroethylene (TCE), and tetrachloroethylene (PCE). Benzene, toluene, ethyl benzene and xylene (BTEX) constituents in that area have been largely reduced due to the process related to the natural degradation of the chlorinated VOCs.
- The most significant indicators of natural attenuation at this site continue to be the presence of degradation daughter compounds. Zones of anoxic and reducing conditions which are necessary for reductive dechlorination to take place are slightly smaller than in previous years but remain present in the vicinity of the MW-10 and MW-13 well clusters.
- Since most of the BTEX compounds have been exhausted as part of the natural degradation of the chlorinated VOCs, the primary organic carbon source remaining, that may continue to support reductive dechlorination, appears to be MC. As a result, degradation rates may be slower in the future, but the chlorinated VOC plume continues to be stable and contained on-site.

The next annual sampling event is scheduled to be conducted in the spring of 2013.

Table 1
June 18, 2012 Groundwater Levels and Groundwater Elevations

Former Sheller-Globe Facility, 3200 Main Street, Keokuk, Iowa

Well I.D.	Top of Casing Elevation ⁽¹⁾ (Feet above MSL)	June 18, 2012	
		Depth to Groundwater (Feet below top of PVC Casing)	Elevation of Groundwater (Feet above MSL)
MW-1	641.22	6.1	635.12
MW-2R ⁽²⁾⁽⁵⁾	640.45	8.5	631.95
MW-3 ⁽²⁾	639.22	13.39	625.83
MW-4 ⁽²⁾	641.17	NM	NM
MW-5 ⁽²⁾	640.97	5.86	635.11
MW-6A	641.37	4.07	637.3
MW-6B	641.22	6.5	634.72
MW-7 ⁽²⁾	638.54	10.69	627.85
MW-8	641.96	5.9	636.06
MW-9 ⁽²⁾	639.07	14.41	624.66
MW-10	624.22	2.35	621.87
MW-10A	624.38	3.11	621.27
MW-11	627.24	NM	NM
MW-11R	627.43	5.07	622.36
MW-12 ⁽²⁾	643.71	6.09	637.62
MW-13 ⁽²⁾	623.56	2.65	620.91
MW-13A ⁽²⁾	623.3	3	620.3
MW-13B ⁽²⁾	623.46	1.92	621.54
MW-14 ⁽⁶⁾	628.55	NM	NM
MW-15 ⁽²⁾	629.62	3.1	626.52
MW-16 ⁽²⁾	623.55	3.64	619.91
MW-17A	620.64	2.63	618.01
MW-17B ⁽³⁾	620.93	1.34	619.59
MW-18	624.79	3.96	620.83
MW-19 ⁽²⁾	624.15	2.96	621.19
MW-20	644.41	8.97	635.44
MW-21	647.59	NM ⁽⁶⁾	NM
MW-22	640.22	NM	NM
MW-23A	621.59	3.58	618.01
MW-23B	621.42	4	617.42
P-1	644.71	NM	NM
P-2	644.62	NM	NM
P-3	641.73	NM	NM
P-4	644.47	NM	NM
P-5	648.84	NM	NM
P-6	640.89	NM	NM
P-7	624.31	NM	NM
P-8	627.64	NM	NM
HW-1		Dry	
HW-2West		Dry	
HW-2East		Dry	
HW-3West		Dry	
HW-3East		Dry	
IW-1		Dry	
IW-2		Dry	
IW-3		Dry	
IW-4		Dry	
IW-5		Dry	
IW-6	631.67	NM ⁽⁴⁾	

- (1) Elevation as surveyed by Shoemaker and Haaland in June 1993. Elevations for MW-19, MW-20, and MW-21 referenced to Shoemaker and Haaland in May 1993. Elevations for P 1-8, MW-10A, MW-11R, MW-22, MW-23A, and MW-23B referenced to Shoemaker and Haaland in February 1999.
- (2) New Top of Casing Elevation after well repair referenced to Shoemaker and Haaland survey in Feb. 1999
- (3) Groundwater in MW-17B stands above ground surface. Water level is measured is above the TOC using a riser extension. Water level measured from a 3.40' riser extension added to the flushmount casing.
- (4) IW-6 is being used with the pump system.
- (5) MW-2R TOC elevation corrected on this table 07-14-09 by DAD, to match other tables. TOC elevation obtained from boring log in 2007 Construction Documentation Report
- (6) MW-21 could not be located

NM - Water level not measured.

TABLE 2
MONITORING WELL AND PIEZOMETER CONSTRUCTION DETAILS

Well I.D.	Date Installed	Elevation of Top of PVC Casing (Feet above MSL)	Elevation of Ground Surface (Feet above MSL)	Total Depth of Boring (Feet)	Borehole Diameter (Inches)	Casing Diameter/ Material (Inches)	Elevation of Top of Screen (Feet above MSL)	Elevation of Bottom of Screen (Feet above MSL)	Geologic Material in Screened Interval
MW-1	Oct-89	641.22	641.59	16.00	NA	4/PVC	636.59	626.59	Fill
MW-2R ⁽¹⁾	Oct-07	640.45	640.97	16.00	8.30	2/PVC	635.45	630.45	Fill
MW-3	Oct-89	639.22	639.56	16.00	NA	4/PVC	634.53	624.53	Fill
MW-5	Nov-90	640.97	641.34	31.50	10.00	4/PVC	610.73	610.70	Weathered Till
MW-6A	Nov-90	641.37	641.65	16.00 ⁽³⁾	8.00	2/PVC	637.20	627.20	Fill
MW-6B	Nov-90	641.22	641.59	32.50	8.00	2/PVC	619.14	609.14	Weathered Till
MW-7	Nov-90	638.54	638.95	41.00	8.00	2/PVC	608.53	598.70	Weathered Till
MW-8	Nov-90	641.96	642.22	31.50	8.00	2/PVC	621.85	611.85	Weathered Till
MW-9	May-91	639.07	639.38	35.00	8.00	2/PVC	615.05	605.05	Weathered Till
MW-10	May-91	624.22	624.46	30.00	9.00	4/PVC	605.04	595.04	Weathered Till
MW-10A	Nov-98	624.38	624.83	8.00	8.00	2/PVC	619.53	617.23	Fill
MW-11 ⁽²⁾	May-91	627.24	627.49	35.00	8.00	2/PVC	603.07	593.07	Weathered Till
MW-11R	Nov-98	627.43	627.82	35.00	8.00	2/PVC	603.32	593.32	Weathered Till
MW-12	May-91	643.71	643.92	35.00	8.00	2/PVC	619.49	609.49	Weathered Till
MW-13	Nov-91	623.56	623.92	29.00	8.00	2/PVC	606.43	596.43	Weathered Till
MW-13A	Oct-92	623.30	623.71	11.00	7.88	2/PVC	618.48	613.48	Fill
MW-13B	Oct-92	623.46	624.12	53.00	7.88	2/PVC	583.59	573.59	Unweathered Glacial Till
MW-14	Nov-91	628.55	629.22	34.00	8.00	2/PVC	606.82	596.82	Weathered Till
MW-15	Nov-91	629.62	630.08	34.00	8.00	2/PVC	607.63	597.63	Weathered Till
MW-16	Oct-92	623.55	624.10	36.00	7.88	2/PVC	598.93	588.93	Weathered Till
MW-17A	Oct-92	620.64	620.92	11.00	7.88	2/PVC	615.72	610.72	Fill
MW-17B	Oct-92	620.93	621.07	35.00	7.88	2/PVC	597.37	587.37	Weathered Till
MW-18	Oct-92	624.79	625.38	36.00	7.88	2/PVC	600.38	590.38	Weathered Till
MW-19	Feb-95	624.15	624.91	29.00	7.25	2/PVC	606.15	596.75	Weathered Till
MW-20	Feb-95	644.41	644.55	39.00	7.25	2/PVC	616.45	606.95	Weathered Till
MW-21	Feb-95	647.59	647.79	54.00	7.25	2/PVC	603.79	594.29	Weathered Till
MW-23A	Nov-98	621.59	621.91	9.50	8.00	2/PVC	616.91	614.11	Fill
MW-23B	Nov-98	621.42	622.01	34.30	8.00	2/PVC	598.81	588.81	Weathered Till
P-1	May-98	644.71	644.96	23.58	2.13	0.5/PVC	630.38	621.38	Weathered Till
P-2	May-98	644.62	644.86	21.96	2.13	0.5/PVC	631.90	622.90	Weathered Till
P-3	May-98	641.73	641.96	17.58	2.13	0.5/PVC	633.38	624.38	Weathered Till
P-4	May-98	644.47	644.69	22.25	2.13	0.5/PVC	631.44	622.44	Weathered Till
P-5	May-98	648.84	649.05	20.92	2.13	0.5/PVC	637.13	628.13	Weathered Till
P-6	Nov-98	640.89	641.23	10.00	8.00	0.5/PVC	636.23	631.53	Weathered Till
P-7	Nov-98	624.31	624.67	10.00	8.00	0.5/PVC	619.67	616.87	Fill
P-8	Nov-98	627.64	628.12	35.00	8.00	0.5/PVC	603.62	593.92	Weathered Till
IW-6 ⁽³⁾	Jul-07	631.67	631.89	~ 10	NA	4/PVC	624	622	Gravel Backfill

Notes:

1. Wells MW-2, MW-4, and MW-22 were abandoned in June 2007. MW-2 was replaced with MW-2R in October 2007.
2. MW-11 abandoned in Nov-98 and replaced with MW-11R
3. IW-6 is currently a pumping well. The well was installed in the excavation backfill during the July 2007 source removal.

TABLE 3
ANALYTICAL RESULTS FOR EQUIPMENT AND TRIP BLANKS
2012 ANNUAL GROUNDWATER SAMPLING EVENT
3200 MAIN STREET, KEOKUK, IOWA

	EB-10			EB-13			EB-23B			TRIP BLANK			TRIP BLANK-002			TRIP BLANK-003			TRIP BLANK-004		
	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit
Volatiles (UG/L)																					
1,1,1-Trichloroethane		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
1,1,2,2-Tetrachloroethane		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38
1,1,2-Trichloroethane		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
1,1-Dichloroethane		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29
1,1-Dichloroethylene		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4
1,2-Dichloroethane		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
1,2-Dichloroethene		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54
1,2-Dichloropropane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
2-Butanone (MEK)		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8
2-Hexanone		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4
4-Methyl-2-pentanone (MIBK)		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9
Acetone		U	10		U	10		U	10		U	10		U	10		U	10		U	10
Benzene		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Bromodichloromethane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Bromoform		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35
Carbon disulfide		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Carbon tetrachloride		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Chlorobenzene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
Chloroethane		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44
Chloroform		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
cis-1,2-Dichloroethene		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24
cis-1,3-Dichloropropene		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Dibromochloromethane		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29
Ethylbenzene		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Hexane		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66
Isobutyl alcohol		U	23		U	23		U	23		U	23		U	23		U	23		U	23
Methyl bromide (Bromomethane)		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
Methyl chloride (Chloromethane)		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27
Methylene chloride		U	1		U	1		U	1		U	1		U	1		U	1		U	1
n-Butanol		U	33		U	33		U	33		U	33		U	33		U	33		U	33
Styrene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
tert-Butyl methyl ether		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28
Tetrachloroethylene		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33
Toluene		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26
trans-1,2-Dichloroethylene		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3
trans-1,3-Dichloropropene		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21
Trichloroethene (TCE)		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Vinyl chloride		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4
Xylene (total)		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71
Total Chlorinated VOCs	0			0			0			0			0			0			0		
Total Non-Chlorinated VOCs	0			0			0			0			0			0			0		
Total VOCs	0			0			0			0			0			0			0		

TABLE 4
ANALYTICAL RESULTS FOR SHALLOW WELLS
2012 ANNUAL GROUNDWATER SAMPLING EVENT
3200 MAIN STREET, KEOKUK, IOWA

	MW-1-2012			MW-2R-2012			MW-3-2012			MW-6A-2012			MW-10A-2012			MW-13A-2012		
	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit
Volatiles (UG/L)																		
1,1,1-Trichloroethane		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
1,1,2,2-Tetrachloroethane		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38
1,1,2-Trichloroethane		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
1,1-Dichloroethane	1		0.29	0.69	J	0.29		U	0.29		U	0.29	1.7		0.29		U	0.29
1,1-Dichloroethylene		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4
1,2-Dichloroethane		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
1,2-Dichloroethene	0.78	J	0.54		U	0.54		U	0.54		U	0.54	1.8	J	0.54		U	0.54
1,2-Dichloropropane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
2-Butanone (MEK)		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8
2-Hexanone		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4
4-Methyl-2-pentanone (MIBK)		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9
Acetone		U	10		U	10		U	10		U	10		U	10		U	10
Benzene		U	0.25		U	0.25		U	0.25	0.29	J	0.25	1.7		0.25		U	0.25
Bromodichloromethane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Bromoform		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35
Carbon disulfide		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Carbon tetrachloride		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Chlorobenzene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
Chloroethane		U	0.44		U	0.44		U	0.44	2.4		0.44		U	0.44		U	0.44
Chloroform		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
cis-1,2-Dichloroethene	0.78	J	0.24	0.49	J	0.24		U	0.24	1.8		0.24		U	0.24		U	0.24
cis-1,3-Dichloropropene		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Dibromochloromethane		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29
Ethylbenzene		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Hexane		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66
Isobutyl alcohol		U	23		U	23		U	23		U	23		U	23		U	23
Methyl bromide (Bromomethane)		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
Methyl chloride (Chloromethane)		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27
Methylene chloride		U	1		U	1	2.4	J	1		U	1		U	1	8.3		1
n-Butanol		U	33		U	33		U	33		U	33		U	33		U	33
Styrene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
tert-Butyl methyl ether		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28
Tetrachloroethylene		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33
Toluene		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26	0.36	J	0.26
trans-1,2-Dichloroethylene		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3
trans-1,3-Dichloropropene		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21
Trichloroethene (TCE)		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Vinyl chloride	0.42	J	0.4		U	0.4		U	0.4		U	0.4	0.45	J	0.4		U	0.4
Xylene (total)		U	0.71		U	0.71		U	0.71	13.2		0.71		U	0.71		U	0.71
Metals (MG/L)																		
Iron	5.9		0.1	0.248		0.1	3.93		0.1	2.84		0.1	6.77		0.1	55.7		0.1
Manganese	3.66		0.015	1.5		0.015	6.19		0.015	2.28		0.015	2.92		0.015	7.48		0.015
Dissolved Gases (UG/L)																		
Ethane		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Ethene		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Methane	89.4		0.3	79.7		0.3	323		0.6	961		3	277		0.6	1520		3
Water Quality (MG/L)																		
Alkalinity, Total	620		5	405		5	355		5	445		5	455		5	490		5
Chloride	248		10	51.9		2.5	163		10	584		25	198		10	1260		100
Nitrate		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Nitrate + Nitrite		U	0.1		U	0.1		U	0.1		U	0.1		U	0.1		U	0.1
Nitrite		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Sulfate	35.8		1	65.4		2.5	37.9		1	6.7		0.5	50.7		2.5	1.9		0.5
Sulfide		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Total Organic Carbon	6.5		1	5.1		1	3.1		1	7.7		1	10.9		1	27.2		1
Total Chlorinated VOCs	2.98			1.18			2.40			0.00			8.15			8.30		
Total Non-Chlorinated VOCs	0.00			0.00			0.00			13.20			0.29			2.06		
Total VOCs	2.98			1.18			2.4			13.2			8.44			10.36		

TABLE 5
ANALYTICAL RESULTS FOR TILL WELLS
2012 ANNUAL GROUNDWATER SAMPLING EVENT
3200 MAIN STREET, KEOKUK, IOWA

	MW-7-2012			MW-10-2012			MW-13-2012			MW-13-DUP-2012			MW-13B-2012			MW-16-2012		
	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit
Volatiles (UG/L)																		
1,1,1-Trichloroethane		U	0.31	96.5		0.31	3.6	J	1.5	4.9	J	1.5		U	0.31		U	0.31
1,1,2,2-Tetrachloroethane		U	0.38		U	0.38		U	1.9		U	1.9		U	0.38		U	0.38
1,1,2-Trichloroethane		U	0.36	2.8		0.36		U	1.8		U	1.8		U	0.36		U	0.36
1,1-Dichloroethane	0.47	J	0.29	14.1		0.29	22.3		1.4	27.9		1.4		U	0.29		U	0.29
1,1-Dichloroethylene		U	0.4	191		0.4	42.1		2	51.7		2		U	0.4		U	0.4
1,2-Dichloroethane	0.94	J	0.2	1.2		0.2		U	0.98	1.4	J	0.98		U	0.2		U	0.2
1,2-Dichloroethene	100		0.54	20.7		0.54	88.9	J	2.7	115	J	2.7		U	0.54		U	0.54
1,2-Dichloropropane		U	0.25	5.6		0.25	4.3	J	1.3	5.4		1.3		U	0.25		U	0.25
2-Butanone (MEK)		U	1.8		U	1.8		U	9.2		U	9.2		U	1.8		U	1.8
2-Hexanone		U	2.4		U	2.4		U	12		U	12		U	2.4		U	2.4
4-Methyl-2-pentanone (MIBK)		U	1.9		U	1.9		U	9.3		U	9.3		U	1.9		U	1.9
Acetone		U	10		U	10		U	50		U	50		U	10		U	10
Benzene		U	0.25	0.31	J	0.25		U	1.2		U	1.2		U	0.25		U	0.25
Bromodichloromethane		U	0.25		U	0.25		U	1.3		U	1.3		U	0.25		U	0.25
Bromoform		U	0.35		U	0.35		U	1.8		U	1.8		U	0.35		U	0.35
Carbon disulfide		U	0.36	0.62	J	0.36		U	1.8		U	1.8		U	0.36		U	0.36
Carbon tetrachloride		U	0.36		U	0.36		U	1.8		U	1.8		U	0.36		J	0.36
Chlorobenzene		U	0.22		U	0.22		U	1.1		U	1.1		U	0.22		U	0.22
Chloroethane		U	0.44		U	0.44		U	2.2		U	2.2		U	0.44		U	0.44
Chloroform	2		0.2	1.5		0.2		U	1		U	1		U	0.2		U	0.2
cis-1,2-Dichloroethene	98.5		0.24	19.8		0.24	88.9		1.2	113		1.2		U	0.24		U	0.24
cis-1,3-Dichloropropene		U	0.2		U	0.2		U	1		U	1		U	0.2		U	0.2
Dibromochloromethane		U	0.29		U	0.29		U	1.4		U	1.4		U	0.29		U	0.29
Ethylbenzene		U	0.25		U	0.25		U	1.3		U	1.3		U	0.25		U	0.25
Hexane		U	0.66		U	0.66		U	3.3		U	3.3		U	0.66		U	0.66
Isobutyl alcohol		U	23		U	23		U	120		U	120		U	23		U	23
Methyl bromide (Bromomethane)		U	0.31		U	0.31		U	1.6		U	1.6		U	0.31		U	0.31
Methyl chloride (Chloromethane)		U	0.27		U	0.27		U	1.3		U	1.3		U	0.27		U	0.27
Methylene chloride		U	1	3550		25	1960	J	50	2530	J	50		U	1		U	1
n-Butanol		U	33		U	33		U	170		U	170		U	33		U	33
Styrene		U	0.22		U	0.22		U	1.1		U	1.1		U	0.22		U	0.22
tert-Butyl methyl ether		U	0.28		U	0.28		U	1.4		U	1.4		U	0.28		U	0.28
Tetrachloroethylene	4.9		0.33	387		8.3	92.5		1.7	119		1.7		U	0.33		U	0.33
Toluene		U	0.26		U	0.26		U	1.3		U	1.3		U	0.26		U	0.26
trans-1,2-Dichloroethylene	1.5		0.3	0.9	J	0.3		U	1.5		U	1.5		U	0.3		U	0.3
trans-1,3-Dichloropropene		U	0.21		U	0.21		U	1.1		U	1.1		U	0.21		U	0.21
Trichloroethene (TCE)	15.9		0.36	868		8.9	220		1.8	287		1.8	0.45	J	0.36		U	0.36
Vinyl chloride	7.4		0.4	1.3		0.4	3.8	J	2	4.3	J	2		U	0.4		U	0.4
Xylene (total)		U	0.71		U	0.71		U	3.6		U	3.6		U	0.71		U	0.71
Metals (MG/L)																		
Iron		U	0.1		U	0.1	0.159	J	0.1	0.398	J	0.1	0.73		0.1	48		0.1
Manganese	0.932		0.015	1.91		0.015	1.85		0.015	2.1		0.015	0.325		0.015	5.89		0.015
Dissolved Gases (UG/L)																		
Ethane	2.75		0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Ethene		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Methane	20.3		0.3	56.3		0.3	112	J	0.3	160	J	0.3	1.74		0.3	744		1.5
Water Quality (MG/L)																		
Alkalinity, Total	430		5	445		5	440		5	465		5	410		5	141		5
Chloride	165		10	133		5	35.2		2.5	42.4		2.5	17.1		0.5	1870		100
Nitrate		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Nitrate + Nitrite		U	0.1		U	0.1		U	0.1		U	0.1		U	0.1	0.13		0.1
Nitrite		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Sulfate	197		10	140		5	190		10	184		10	425		25	23.8		1
Sulfide		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Total Organic Carbon	1.8		1	1.9		1	1.9		1	2.2		1	2.1		1	6.8		1
Total Chlorinated VOCs	231.61			5160.40			2526.40			3259.60			0.45			0.00		
Total Non-Chlorinated VOCs	0.00			0.93			0.00			0.00			0.00			0.00		
Total VOCs	231.61			5161.33			2526.4			3259.6			0.45			0		

TABLE 6
ANALYTICAL RESULTS FOR PROPERTY LINE AND SENTINEL WELLS
2012 ANNUAL GROUNDWATER SAMPLING EVENT
3200 MAIN STREET, KEOKUK, IOWA

	MW-17A-2012			MW-17B-2012			MW-17B-DUP-2012			MW-19-2012			MW-20-2012			MW-23A-2012			MW-23B-2012		
	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit	Result	Qualifier	Detection Limit
Volatiles (UG/L)																					
1,1,1-Trichloroethane		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
1,1,2,2-Tetrachloroethane		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38		U	0.38
1,1,2-Trichloroethane		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
1,1-Dichloroethane		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29
1,1-Dichloroethylene		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4		U	0.4
1,2-Dichloroethane		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
1,2-Dichloroethene		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54		U	0.54
1,2-Dichloropropane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
2-Butanone (MEK)		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8		U	1.8
2-Hexanone		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4		U	2.4
4-Methyl-2-pentanone (MIBK)		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9		U	1.9
Acetone		U	10		U	10		U	10		U	10		U	10		U	10		U	10
Benzene		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Bromodichloromethane		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Bromoform		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35		U	0.35
Carbon disulfide		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Carbon tetrachloride		U	0.36		U	0.36		U	0.36	0.36	J	0.36		U	0.36		U	0.36		U	0.36
Chlorobenzene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
Chloroethane		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44		U	0.44
Chloroform		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
cis-1,2-Dichloroethene		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24		U	0.24
cis-1,3-Dichloropropene		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Dibromochloromethane		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29		U	0.29
Ethylbenzene		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25		U	0.25
Hexane		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66		U	0.66
Isobutyl alcohol		U	23		U	23		U	23		U	23		U	23		U	23		U	23
Methyl bromide (Bromomethane)		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31		U	0.31
Methyl chloride (Chloromethane)		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27		U	0.27
Methylene chloride		U	1		U	1		U	1		U	1		U	1		U	1		U	1
n-Butanol		U	33		U	33		U	33		U	33		U	33		U	33		U	33
Styrene		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22		U	0.22
tert-Butyl methyl ether		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28		U	0.28
Tetrachloroethylene		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33		U	0.33
Toluene		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26		U	0.26
trans-1,2-Dichloroethylene		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3		U	0.3
trans-1,3-Dichloropropene		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21		U	0.21
Trichloroethene (TCE)		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36		U	0.36
Vinyl chloride		U	0.4	0.46	J	0.4	0.4	J	0.4		U	0.4		U	0.4		U	0.4		U	0.4
Xylene (total)		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71		U	0.71
Metals (MG/L)																					
Iron		U	0.1	0.276		0.1	0.44		0.1		U	0.1	0.728		0.1	56.9		0.1		U	0.1
Manganese	0.999		0.015	0.724		0.015	0.703		0.015	0.0205		0.015	0.829		0.015	4.72		0.015	0.19		0.015
Dissolved Gases (UG/L)																					
Ethane		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Ethene		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Methane	4.59		0.3	7.15	J	0.3	11	J	0.3	4.78		0.3	74.6		0.3	973		15		U	0.3
Water Quality (MG/L)																					
Alkalinity, Total	315		5	260	J	5	365	J	5	390		5	490		5	215		5	390		5
Chloride	80.9		5	51.2		2.5	52.3		2.5	278		25	56.1		2.5	1950		100	67.7		5
Nitrate		U	0.5		U	0.5		U	0.5	0.65		0.5		U	0.5		U	0.5	5.3		0.5
Nitrate + Nitrite		U	0.1		U	0.1		U	0.1	0.43		0.1		U	0.1	0.2		0.1	6.3		0.2
Nitrite		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5		U	0.5
Sulfate	109		5	347		25	339		25	254		25	67.9		2.5	1.6		0.5	141		5
Sulfide		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2		U	0.2
Total Organic Carbon	8.2		1	1.4		1	1.5		1	1.6		1	2.3		1	22.3		1	1.4		1
Total Chlorinated VOCs	0			0.46			0.4			0.36			0			0			0		
Total Non-Chlorinated VOCs	0			0			0			0			0			0			0		
Total VOCs	0			0.46			0.4			0.36			0			0			0		

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-01-2012Personnel: CA/JCWell: MW-01QA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 6.08WL Date: 6-20-12 WL Time: 7:30

Well Development/Purging

Date: 6-20-12Top of Screen (ft TOC) 4.60Bottom of Screen (ft TOC) 14.60Well Depth, Constructed (ft) 16.00Well Depth, Sounded (ft): Pump Depth (ft TOC): 10.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 5.99 (after): 9.70Casing Diameter (in): 4

Well volume above pump intake:

$$[(\text{ ft} \times 1.43 \text{ gal/ft}) + (\text{ ft} - \text{ ft})] \times 0.66 \text{ ft/gal} = \text{ gal} \times \text{ L/gal} = \text{ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{ ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{ L}$$

Time	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	
Temperature (°C)	18.64	18.37	18.78	18.70	18.75	18.74	18.71		
Conduct (mmhos/cm)	1.625	1.606	1.597	1.589	1.583	1.590	1.599		
pH	6.84	6.83	6.83	6.81	6.81	6.81	6.82		
D.O. (mg/l)	0.4	0.31	0.21	0.18	0.17	0.19	0.19		
ORP (mv)	-94.9	-94.5	-94.2	-95.1	-95.3	-94.9	-94.6		
Turbidity (NTU)	7.72	7.8	6.07	4.31	3.73	3.89	3.91		
Water Level (ft)	8.10	8.35	8.75	8.95	9.20	9.50	9.70		
Pump Rate (L/min)	125	100	100	100	100	100	100		
Volume (L)	1	1.2	1.9	2.0	2.4	2.8	3.1		

Sampling

Date: 6-20-12 Time: 8:50 Method: Bladder pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-02R-2012Personnel: CA/JCWell: MW-02RQA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 8.56WL Date: 6.20.12WL Time: 9:30

Well Development/Purging

Date: 6.20.12Top of Screen (ft TOC) 5.20Bottom of Screen (ft TOC) 15.20Well Depth, Constructed (ft) 15.20Well Depth, Sounded (ft): Pump Depth (ft TOC): 14'Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 8.44(after): 10.89Casing Diameter (in): 2 X

Well volume above pump intake:

$$[(\text{ ft} \times 1.43 \text{ gal/ft}) + (\text{ ft} - \text{ ft})] \times 0.66 \text{ ft/gal} = \text{ gal} \times \text{ L/gal} = \text{ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{ ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{ L}$$

Time	9:50	9:55	10:00	10:05	10:10	10:15	10:20	10:25	10:30
Temperature (°C)	20.48	20.55	20.71	21.00	21.09	21.24	21.50	21.51	
Conduct (mmhos/cm)	0.871	0.875	0.887	0.906	0.914	0.929	0.940	0.937	
pH	6.99	7.00	6.98	6.99	7.01	7.04	7.08	7.06	
D.O. (mg/l)	0.31	0.32	0.36	0.37	0.37	0.36	0.24	0.20	
ORP (mv)	-112.0	-106.7	-100.2	-96.4	-94.0	-98.0	-104.2	-103.9	
Turbidity (NTU)	98.7	63.2	31.9	17.1	11.3	10.13	10.10	10.0	
Water Level (ft)	9.40	9.61	9.85	10.09	10.29	10.52	10.76	10.89	
Pump Rate (L/min)	60	60	60	60	60	60	60	60	
Volume (L)	60.0	60.4	60.8	61.2	61.6	62.0	62.4	62.8	

Sampling

Date: 6.20.12Time: 10:30Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.0020tSample Number: MW-03-2012Personnel: TJS, CRFWell: MW-03QA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 13.06WL Date: 6-20-12WL Time: 1050

Well Development/Purging

Date: 6-20-12Top of Screen (ft TOC) 4.70Bottom of Screen (ft TOC) 14.70Well Depth, Constructed (ft) 16.00Well Depth, Sounded (ft): 16.71
+13.21 TJSPump Depth (ft TOC): 14.0'Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 13.06 (after): 13.21Casing Diameter (in): 4

Well volume above pump intake:

$$[(\text{ft} \times 1.43 \text{ gal/ft}) + (\text{ft} - \text{ft})] \times 0.66 \text{ ft/gal} = \text{gal} \times \text{L/gal} = \text{L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{L}$$

Time	1100	1105	1110	1120	1125	1130	1135		
Temperature (°C)	16.50	16.14	16.09	16.67	17.10	17.35	17.35		
Conduct (mmhos/cm)	988	1003	985	978	990	997	996		
pH	6.61	6.69	6.70	6.69	6.67	6.67	6.67		
D.O. (mg/l)	1.49	0.61	0.55	0.56	0.57	0.53	0.54		
ORP (mv)	-19.9	-31.5	-25.5	-21.2	-18.6	-18.6	-18.2		
Turbidity (NTU)	15.9	14.8	16.2	12.0	10.9	11.0	8.6		
Water Level (ft)	13.78	13.92	14.08	14.25	14.29	14.29	14.29		
Pump Rate (L/min)	.12	.12	.12	.1	.1	.1	.1		
Volume (L)	0.6	1.2	1.8	2.8	3.3	3.8	4.2		

Sampling

Date: 6-20-12 Time: 1140 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: * Set pump intake at 15.5' BTOC.

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IA

Project Number: 16530531.00201

Sample Number: MW-06A-2012

Personnel: TJS, CRV

Well: MW-06A

QA/QC Sample Yes ☒ No ☐

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 4.19

WL Date: 6-20-12 WL Time: 0900

Well Development/Purging

Date: 6-20-12

Top of Screen (ft TOC) 4.20

Bottom of Screen (ft TOC) 14.20

Well Depth, Constructed (ft) 16.00

Well Depth, Sounded (ft): 13.95

Pump Depth (ft TOC): 9.0

Method/Pump Type: Bladder Pump

Water Level w/ Pump in (ft) (before): 4.19 (after): 3.33

Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{ft} \times 0.78\text{gal/ft}) + (\text{ft} - \text{ft})] \times 0.17\text{ft/gal} = \text{gal} \times \text{L/gal} = \text{L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{L}$$

Time	0925	0930	0935	0940	0945	0955	1000	1005	1010
Temperature (°C)	21.01	20.58	20.55	20.60	21.38	21.04	21.05	21.35	
Conduct (mmhos/cm)	3671	3678	3660	3627	3525	3117	3100	3094	
pH	6.85	6.84	6.87	6.87	6.87	6.88	6.89	6.89	
D.O. (mg/l)	0.84	0.62	0.48	0.41	0.34	0.30	0.29	0.29	
ORP (mv)	-72.4	-73.4	-70.5	-71.0	-71.8	-71.8	70.7	-72.7	
Turbidity (NTU)	13.5	12.2	9.5	7.18	6.0	7.5	6.1	5.1	
Water Level (ft)	4.31	4.55	4.72	4.85	4.91	5.30	5.30	5.23	
Pump Rate (L/min)	.15	.15	.15	.15	.15	.15	.1	.1	
Volume (L)	.75	1.5	2.25	3.0	3.75	5.25	6.00	6.5	

Sampling

Date: 6-19-12 Time: 1010 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IA

Project Number: 16530531.00201

Sample Number: MW-07-2012

Personnel: CAC

Well: MW-07

QA/QC Sample Yes ☒ No ☐

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 10.66

WL Date: 6-20-12

WL Time: 1220

Well Development/Purging

Date: _____

Top of Screen (ft TOC) 30.00

Bottom of Screen (ft TOC) 39.80

Well Depth, Constructed (ft) 41.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 33.00

Method/Pump Type: Bladder Pump

Water Level w/ Pump in (ft) (before): 9.70

(after): 13.17

Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{_____ ft} \times 0.78\text{gal/ft}) + (\text{_____ ft} - \text{_____ ft}) \times 0.17\text{ft/gal}] = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{_____ ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{_____ L}$$

Time	1240	1245	1250	1255	1300	1305	1310	1315	1320
Temperature (°C)	20.92	20.15	19.84	19.56	19.95	20.32	20.76	20.57	20.53
Conduct (mmhos/cm)	1.424	1.404	1.394	1.386	1.389	1.405	1.417	1.415	1.414
pH	6.72	6.74	6.74	6.73	6.72	6.73	6.73	6.73	6.74
D.O. (mg/l)	1.21	0.78	0.56	0.44	0.39	0.34	0.31	0.31	0.30
ORP (mv)	19.1	19.7	22.3	23.3	24.0	24.6	24.9	23.7	24.1
Turbidity (NTU)	9.4	8.37	7.05	5.44	4.91	6.05	3.33	2.39	2.38
Water Level (ft)	11.45	11.94	12.41	12.71	12.86	13.00	13.02	13.12	13.17
Pump Rate (L/min)	75	75	75	75	85	75	75	75	75
Volume (L)	1	1.3	1.5	1.9	2.2	2.9	3.5	3.8	4.1

Sampling

Date: 6-20-12 Time: 1325

Method: Bladder pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-10-2012Personnel: CA/SCWell: MW-10QA/QC Sample Yes No

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 2.54WL Date: 6.20.12WL Time: 14:10

Well Development/Purging

Date: _____

Top of Screen (ft TOC) 19.2Bottom of Screen (ft TOC) 29.2Well Depth, Constructed (ft) 30.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 26Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.22(after): 3.73Casing Diameter (in): 4

Well volume above pump intake:

$$[(\text{_____ ft} \times 1.43 \text{ gal/ft}) + (\text{_____ ft} - \text{_____ ft})] \times 0.66 \text{ ft/gal} = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{_____ ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{_____ L}$$

Time	<u>1430</u>	<u>1435</u>	<u>1440</u>	<u>1445</u>	<u>1450</u>	<u>1455</u>	<u>1500</u>	<u>1505</u>	
Temperature (°C)	<u>22.31</u>	<u>24.12</u>	<u>24.58</u>	<u>24.72</u>	<u>24.98</u>	<u>25.10</u>	<u>25.01</u>		
Conduct (mmhos/cm)	<u>1.304</u>	<u>1.325</u>	<u>1.373</u>	<u>1.375</u>	<u>1.343</u>	<u>1.387</u>	<u>1.384</u>		
pH	<u>6.72</u>	<u>6.74</u>	<u>6.74</u>	<u>6.73</u>	<u>6.74</u>	<u>6.74</u>	<u>6.75</u>		
D.O. (mg/l)	<u>0.62</u>	<u>0.80</u>	<u>0.98</u>	<u>1.15</u>	<u>1.31</u>	<u>1.41</u>	<u>1.51</u>		
ORP (mv)	<u>-10.4</u>	<u>-14.7</u>	<u>-15.9</u>	<u>-15.7</u>	<u>-16.1</u>	<u>-16.0</u>	<u>-15.7</u>		
Turbidity (NTU)	<u>2.72</u>	<u>3.27</u>	<u>2.03</u>	<u>2.40</u>	<u>2.03</u>	<u>2.06</u>	<u>2.17</u>		
Water Level (ft)	<u>3.10</u>	<u>3.22</u>	<u>3.32</u>	<u>3.41</u>	<u>3.52</u>	<u>3.60</u>	<u>3.61</u>		
Pump Rate (L/min)	<u>80</u>	<u>75</u>	<u>75</u>	<u>75</u>	<u>75</u>	<u>75</u>	<u>75</u>		
Volume (L)	<u>2</u>	<u>3</u>	<u>3.5</u>	<u>3.9</u>	<u>4.1</u>	<u>4.6</u>	<u>5.1</u>		

Sampling

Date: 6.20.12 Time: 1505 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IA

Project Number: 16530531.00201

Sample Number: MW-10A-2012

Personnel: TJS, KRY

Well: MW-10A

QA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 3.21

WL Date: 6-20-12

WL Time: 1400

Well Development/Purging

Date: 6-20-12

Top of Screen (ft TOC) 4.90

Bottom of Screen (ft TOC) 7.10

Well Depth, Constructed (ft) 8.00

Well Depth, Sounded (ft):

Pump Depth (ft TOC): 6.20

Method/Pump Type: Bladder Pump

Water Level w/ Pump in (ft) (before): 3.21

(after): 2.71

Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{ } \text{ft} \times 0.78 \text{gal/ft}) + (\text{ } \text{ft} - \text{ } \text{ft})] \times 0.17 \text{ft/gal} = \text{ } \text{gal} \times \text{ } \text{L/gal} = \text{ } \text{L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{L} + (\text{ } \text{ft} \times 0.022 \text{L/ft}) + 0.5 \text{L} + 2.6 \text{L} = \text{ } \text{L}$$

Time	1415	1420	1430	1440	1450	1500	1505	1510	
Temperature (°C)	23.98	24.03	23.08	22.27	22.97	23.21	23.20	23.33	
Conduct (mmhos/cm)	1554	1554	1504	1472	1491	1505	1505	1510	
pH	6.82	6.83	6.83	6.80	6.76	6.75	6.75	6.75	
D.O. (mg/l)	0.87	0.55	1.78	1.71	0.99	0.74	0.71	0.70	
ORP (mv)	-61.1	-53.9	-55.7	-58.7	-60.4	-62.0	-61.9	-64.3	
Turbidity (NTU)	>500	>500	>100	99	46.8	26.3	15.5	13.3	
Water Level (ft)	3.70	3.96	4.22	4.70	4.70	4.73	4.71	4.71	
Pump Rate (L/min)	.12	.12	.12	.12	.1	.1	.1	.1	
Volume (L)	.6	1.2	1.8	2.4	3.4	4.4	5.9	6.4	

Sampling

Date: 6-20-12 Time: 1515 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-13-2012Personnel: CA/SCWell: MW-13QA/QC Sample ☒ Yes ☐ NoDuplicate

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): _____

WL Date: 6-21-12WL Time: 7:40

Well Development/Purging

Date: 6-21-12Top of Screen (ft TOC) 17.10Bottom of Screen (ft TOC) 27.10Well Depth, Constructed (ft) 29.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 23-0'Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.15(after): 4.45Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{_____ ft} \times 0.78 \text{ gal/ft}) + (\text{_____ ft} - \text{_____ ft}) \times 0.17 \text{ ft/gal}] = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\text{_____ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = \text{_____ L}$$

Time	8:00	8:05	8:10	8:15	8:20	8:25			
Temperature (°C)	19.72	20.03	19.76	19.86	19.99	19.98			
Conduct (mmhos/cm)	1.017	1.025	1.019	1.024	1.037	1.031			
pH	6.69	6.72	6.71	6.70	6.70	6.69			
D.O. (mg/l)	0.69	0.53	0.41	0.35	0.32	0.31			
ORP (mv)	-16.7	-15.9	-10.5	-8.2	-10.3	-12.1			
Turbidity (NTU)	4.45	3.48	2.33	3.33	3.79	4.01			
Water Level (ft)	4.15	4.36	4.42	4.45	4.44	4.45			
Pump Rate (L/min)	150	150	150	125	125	125			
Volume (L)	1	2	3	3.7	4.1	5			

Sampling

Date: 6-21-12 Time: 8:30Method: Bladder pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-13A-2012Personnel: TJS, CRYWell: MW-13AQA/QC Sample Yes No

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 2.82WL Date: 6-21-12WL Time: 0730

Well Development/Purging

Date: 6-21-12Top of Screen (ft TOC) 4.80Bottom of Screen (ft TOC) 9.80Well Depth, Constructed (ft) 11.00Well Depth, Sounded (ft): Pump Depth (ft TOC): 7.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.82 (after): 2.55Casing Diameter (in): 2

Well volume above pump intake:

$$[(2.2 \text{ ft} \times 0.78 \text{ gal/ft}) + (7 \text{ ft} - 2.82 \text{ ft}) \times 0.17 \text{ gal/ft}] = \text{gal} \times \text{L/gal} = 2.4 \text{ L}$$

1.7 4.18 = .7

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (10 \text{ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = 4.5 \text{ L}$$

0745 2.2 7.3 3.1 L (system volume)

Time	0750	0755	0800	0805	0810	0815	0820	0825	0830
Temperature (°C)	22.65	22.95	23.10	23.61	24.12	24.05	23.99	23.99	23.99
Conduct (mmhos/cm)	4563	4961	4607	4657	4711	4693	4672	4667	4656
pH	6.39	6.39	6.39	6.40	6.40	6.40	6.40	6.40	6.40
D.O. (mg/l)	1.20	1.04	0.90	0.57	0.49	0.39	0.38	0.35	0.35
ORP (mv)	-47.1	-46.1	-40.0	-35.2	-35.4	-45.7	-38.5	-39.1	-38.9
Turbidity (NTU)	91	79	80	85	100.2	62.3	65.0	50.1	41.7
Water Level (ft)	4.00	4.11	4.13	4.15	4.25	4.52	4.82	5.05	5.33
Pump Rate (L/min)	.08	.05	.05	.05	.05	.1	.1	.1	.1
Volume (L)	.4	.650	.900	1.125	1.375	2.8	2.3	2.8	2.3

Sampling

Date: 6-21-12 Time: 0835 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: This well historically does not stabilize. The water level could not be maintained at .05 L/min. We removed one system volume and collected a sample.

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-13B-2012Personnel: TJS, CRYWell: MW-13BQA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 2.10WL Date: 6-21-12 WL Time: 0920

Well Development/Purging

Date: 6-21-12Top of Screen (ft TOC) 39.90Bottom of Screen (ft TOC) 49.90Well Depth, Constructed (ft) 53.00Well Depth, Sounded (ft): Pump Depth (ft TOC): 45.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.10 (after): 0.5Casing Diameter (in): 2

Well volume above pump intake:

$$[(\underline{5.0} \text{ ft} \times 0.78 \text{ gal/ft}) + (\underline{\quad} \text{ ft} - \underline{\quad} \text{ ft}) \times 0.17 \text{ ft/gal}] = \underline{\quad} \text{ gal} \times \underline{3.8} \text{ L/gal} = \underline{\quad} \text{ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\underline{5.0} \text{ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + \underline{2.6} \text{ L} = \underline{2.9} \text{ L}$$

0935

Time	0930	0950	1000	1010	1025	1030	1035	1040	1045
Temperature (°C)	19.65	19.00	18.85	18.62	18.29	20.95	22.83	24.08	24.73
Conduct (mmhos/cm)	130.5	128.5	12.81	12.72	12.65	133.4	139.2	142.8	145.4
pH	6.83	6.87	6.88	6.87	6.89	6.88	6.88	6.88	6.88
D.O. (mg/l)	0.83	1.00	1.54	2.19	2.54	3.00	2.94	2.85	2.88
ORP (mv)	-27.9	-21.4	-14.5	-8.6	-6.3	-5.2	-6.3	-7.4	-7.2
Turbidity (NTU)	>500	67.9	46.2	33.7	19.2	12.0	27.5	20.0	20.5
Water Level (ft)	4.65	8.15	11.42	15.88	20.52	20.79	20.85	20.97	21.09
Pump Rate (L/min)	.3	.3	.3	.4	.4	.05	.05	.05	.05
Volume (L)	1.5	4.5	6.0	10.0	16.0	16.25	16.5	16.75	17.0

Sampling

Date: 6-21-12 Time: 1050 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: The w.l. was dropped to $\approx 20'$ initially. Low flow sampling was attempted at 50ml/min but the w.l. continued to drop. This is historically typical of this well, two system volumes were purged then the samples collected.

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-16-2012Personnel: CA & JCWell: MW-16QA/QC Sample Yes No

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): _____

WL Date: _____ WL Time: _____

Well Development/Purging

Date: 6.19.12Top of Screen (ft TOC) 24.60Bottom of Screen (ft TOC) 34.60Well Depth, Constructed (ft) 36.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 30.00Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.97 (after): 11.98Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{_____ ft} \times 0.78 \text{ gal/ft}) + (\text{_____ ft} - \text{_____ ft})] \times 0.17 \text{ ft/gal} = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\text{_____ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = \text{_____ L}$$

Time	11:40	11:45	11:50	11:55	12:00	12:05	12:10	12:15	12:20
Temperature (°C)	17.44	17.3	17.63	17.58	17.64	17.78	17.88	17.78	
Conduct (mmhos/cm)	6.033	5.899	5.817	5.69	5.62	5.531	5.499	5.397	
pH	6.48	6.51	6.55	6.58	6.59	6.62	6.61	6.63	
D.O. (mg/l)	1.69	1.24	1.04	.82	.78	.64	.53	.42	
ORP (mv)	-67.7	-72.4	-76.5	-80.8	-81.5	-85.2	-85.7	-87.7	
Turbidity (NTU)	35	28.8	29.3	24.5	23.5	19.9	19.7	18.8	
Water Level (ft)	8.90	9.30	9.85	10.25	10.55	10.85	10.95	11.18	
Pump Rate (L/min)	100	100	100	100	100	100	100	100	
Volume (L)	3	4	4.5	5	5.5	6	6.5	7.0	

Sampling

Date: 6.19.12 Time: 12:20 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-17A-2012Personnel: TJS, CRYWell: MW-17AQA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 3.40WL Date: 6-19-12WL Time: 0850

Well Development/Purging

Date: 6-19-12Top of Screen (ft TOC) 4.90Bottom of Screen (ft TOC) 9.90Well Depth, Constructed (ft) 11.00Well Depth, Sounded (ft): 10.95Pump Depth (ft TOC): 9.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 2.40(after): 3.47Casing Diameter (in): 2

Well volume above pump intake:

$$[(5.0 \text{ ft} \times 0.78 \text{ gal/ft}) + (4.90 \text{ ft} - 3.40 \text{ ft}) \times 0.17 \text{ ft/gal}] = 4.15 \text{ gal} \times 3.73 \text{ L/gal} = 15.5 \text{ L}$$

3.9 0.25

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (15 \text{ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = 3.13 \text{ L}$$

1.8 *

Time	0855	0900	0915	0925	1020	1025	1035	1040	1045	1050
Temperature (°C)	16.99	17.42	18.60	19.26	24.72	25.69	23.26	22.82	22.28	22.07
Conduct (mmhos/cm)	662	458	652	768	1007	1074	1089	1084	1074	1079
pH	7.07	7.05	6.97	6.95	7.04	7.06	7.00	6.99	6.99	6.98
D.O. (mg/l)	2.25	2.01	1.90	1.18	0.68	0.27	0.23	0.24	0.24	0.25
ORP (mv)	-65.4	-39.7	-41.7	-52.1	-76.8	-99.2	-92.8	-94.4	-91.8	-89.3
Turbidity (NTU)	10.10	30.3	13.2	10.2	15.10	42.2	90	17.2	20.6	19.9
Water Level (ft)	4.81	5.11	7.04	7.21	5.71	5.01	5.20	5.71	5.70	5.68
Pump Rate (L/min)	400	250	100	100	050	050	050	050	050	050
Volume (L)	2.0	4.5	6.25	8.25	7.25	7.50	7.750	8.00	8.25	8.50

6.0 7.0

Sampling

Date: 6-19-12 Time: 1100 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: * stopped pump to adjust flow rate and pump pressure. Pumping began again at 1015 at 50 ml/min.

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: t6530531.00201Sample Number: MW-17B-20 t2Personnel: TJS, CRYWell: MW-17B

QA/QC Sample

☒ Yes ☒ No TJS

Water Level Measurement

Duplicate

Depth to Water, From Top of Riser Pipe (ft): 1.41WL Date: 6-19-12WL Time: 1145

Well Development/Purging

Date: 6-19-12Top of Screen (ft TOC) 23.60Bottom of Screen (ft TOC) 33.60Well Depth, Constructed (ft) 35.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 31.6' 30.0'Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 1.41 (after): 0Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{_____ ft} \times 0.78 \text{ gal/ft}) + (\text{_____ ft} - \text{_____ ft}) \times 0.17 \text{ ft/gal}] = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\text{_____ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = \text{_____ L}$$

Time	1155	1200	1205	1210	1215	1220	1230	1235	1240
Temperature (°C)	23.26	23.18	23.15	23.44	22.10	22.07	22.65	22.77	22.87
Conduct (mmhos/cm)	1481	1475	1490	1486	1447	1442	1461	1468	1463
pH	6.76	6.78	6.80	6.80	6.77	6.78	6.76	6.77	6.77
D.O. (mg/l)	0.74	0.50	0.44	0.43	0.41	0.40	0.31	0.32	0.32
ORP (mv)	-8.0	-9.0	-9.2	-9.6	-7.2	-6.9	-6.9	-8.8	-8.1
Turbidity (NTU)	25	800	750	—	125	103.8	34.3	22.9	20.4
Water Level (ft)	1.79	2.05	2.09	2.07	2.30	2.30	2.30	2.30	2.30
Pump Rate (L/min)	.150	.150	.150	.150	.150	.150	.150	.150	.150
Volume (L)	.75	1.5	2.25	3.0	3.75	4.50	6.0	6.75	7.50

Sampling

Date: 6-12-12 Time: 1245 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: Height of added riser above original PVC = 3.10'

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-19-2012Personnel: CA/JCWell: MW-19QA/QC Sample ☒ Yes ☐ NoMS
MSD

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 3.05WL Date: 6-19-12WL Time: 14:20

Well Development/Purging

Date: 6-19-12Top of Screen (ft TOC) 18.00Bottom of Screen (ft TOC) 27.40Well Depth, Constructed (ft) 29.00

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 23.00Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 4.70(after): 5.87Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{_____ ft} \times 0.78 \text{ gal/ft}) + (\text{_____ ft} - \text{_____ ft}) \times 0.17 \text{ ft/gal}] = \text{_____ gal} \times \text{_____ L/gal} = \text{_____ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\text{_____ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = \text{_____ L}$$

Time	1440	1445	1450	1455	1500	1505	1510		
Temperature (°C)	14.82	14.66	14.42	14.57	14.58	14.50	14.48		
Conduct (mmhos/cm)	1.566	1.584	1.595	1.601	1.626	1.628	1.627		
pH	6.70	6.72	6.72	6.71	6.74	6.74	6.73		
D.O. (mg/l)	1.71	1.60	1.48	1.45	1.39	1.34	1.31		
ORP (mv)	21.7	24.3	26.7	28.5	27.0	26.4	27.5		
Turbidity (NTU)	13.8	12.5	7.45	5.99	6.11	6.13	6.12		
Water Level (ft)	5.29	5.60	5.75	5.82	5.85	5.85	5.85		
Pump Rate (L/min)	150	150	150	130	130	130	130		
Volume (L)	2	2.5	2.8	3	3.2	3.5	3.7		

Sampling

Date: 6-19-12Time: 1515Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-20-2012Personnel: TJS, CRYWell: MW-20QA/QC Sample Yes (No)

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 9.19WL Date: 6-20-12WL Time: 0745

Well Development/Purging

Date: 6-20-12Top of Screen (ft TOC) 28.00Bottom of Screen (ft TOC) 37.50Well Depth, Constructed (ft) 39.00Well Depth, Sounded (ft): Pump Depth (ft TOC): 32.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 9.19 (after): 8.06Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{ } \text{ ft} \times 0.78 \text{ gal/ft}) + (\text{ } \text{ ft} - \text{ } \text{ ft})] \times 0.17 \text{ ft/gal} = \text{ } \text{ gal} \times \text{ } \text{ L/gal} = \text{ } \text{ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\text{ } \text{ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = \text{ } \text{ L}$$

Time	0805	0815	0825	0830	0835	0840			
Temperature (°C)	17.77	17.87	17.91	17.95	17.96	18.16			
Conduct (mmhos/cm)	983	987	988	989	989	994			
pH	6.78	6.81	6.83	6.84	6.82	6.83			
D.O. (mg/l)	1.55	1.15	0.99	0.92	0.89	0.86			
ORP (mv)	-37.1	-36.9	-32.0	-31.9	-31.7	-31.1			
Turbidity (NTU)	13.6	10.0	6.5	6.7	7.0	7.4			
Water Level (ft)	10.79	13.40	15.90	15.99	15.91	15.88			
Pump Rate (L/min)	.2	.2	.2	.2	.2	.2			
Volume (L)	1.0	3.0	5.0	6.0	7.0	8.0			

Sampling

Date: 6-20-12 Time: 0845 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IAProject Number: 16530531.00201Sample Number: MW-23A-2012Personnel: TJS/CRYWell: MW-23AQA/QC Sample Yes ☒ No ☐

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 288WL Date: 6-19-12WL Time: 1430

Well Development/Purging

Date: _____

Top of Screen (ft TOC) 4.70Bottom of Screen (ft TOC) 7.50Well Depth, Constructed (ft) 9.50

Well Depth, Sounded (ft): _____

Pump Depth (ft TOC): 8.0Method/Pump Type: Bladder PumpWater Level w/ Pump in (ft) (before): 288 (after): 2.45Casing Diameter (in): 2

Well volume above pump intake:

$$[(\frac{.5}{0.4} \text{ ft} \times 0.78 \text{ gal/ft}) + (\frac{4.70}{0.4} \text{ ft} - 2.45 \text{ ft}) \times 0.17 \text{ ft/gal}] = 0.8 \text{ gal} \times 3.73 \text{ L/gal} = 0.6 \text{ L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5 \text{ L} + (\frac{10}{0.022} \text{ ft} \times 0.022 \text{ L/ft}) + 0.5 \text{ L} + 2.6 \text{ L} = 1.82 \text{ L}$$

Time	1435	1440	1445	1450	1455				
Temperature (°C)	25.48	27.0	28.55	29.08	29.50				
Conduct (mmhos/cm)	6707	6500	6726	6804	6848				
pH	6.62	6.58	6.57	6.56	6.58				
D.O. (mg/l)	0.73	0.56	0.45	0.41	0.36				
ORP (mv)	-78.1	-77.9	-78.2	-84.0	-83.8				
Turbidity (NTU)	82	70.1	67.9	49.6	40.4				
Water Level (ft)	4.38	4.73	4.90	5.11	5.33				
Pump Rate (L/min)	0.080	0.080	0.080	0.090	0.080				
Volume (L)	0.400	0.8	1.2	1.6	2.2				

Sampling

Date: 6-19-12 Time: 1500 1300-25 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes: Lowered pump to bottom. Intake is at 6.85 ft.

GROUNDWATER SAMPLE COLLECTION FIELD SHEET

Project Name: Facility at 3200 Main, Keokuk, IA

Project Number: 16530531.00201

Sample Number: MW-23B-2012

Personnel: TJS, CRY

Well: MW-23B

QA/QC Sample Yes ☒ No ☐

Water Level Measurement

Depth to Water, From Top of Riser Pipe (ft): 3.47

WL Date: 6-19-12 WL Time: 1515

Well Development/Purging

Date: 6-19-12

Top of Screen (ft TOC) 22.60 Bottom of Screen (ft TOC) 32.60

Well Depth, Constructed (ft) 34.30 Well Depth, Sounded (ft): 33.20

Pump Depth (ft TOC): 27.0 Method/Pump Type: Bladder Pump

Water Level w/ Pump in (ft) (before): 3.47 (after): 2.51

Casing Diameter (in): 2

Well volume above pump intake:

$$[(\text{ft} \times 0.78\text{gal/ft}) + (\text{ft} - \text{ft})] \times 0.17\text{ft/gal} = \text{gal} \times \text{L/gal} = \text{L}$$

System Volume = pump capacity + tubing + flow thru cell + sample bottles:

$$0.5\text{L} + (\text{ft} \times 0.022\text{L/ft}) + 0.5\text{L} + 2.6\text{L} = \text{L}$$

Time	1540	1545	1555	1605	1615	1620	1625	1630	
Temperature (°C)	21.62	19.91	19.52	18.71	17.10	17.54	17.72	17.55	
Conduct (mmhos/cm)	1209	1146	1115	1100	1036	1029	1030	1023	
pH	6.95	7.04	7.15	7.10	7.04	7.11	7.11	7.09	
D.O. (mg/l)	1.94	4.30	6.71	8.13	7.70	6.59	6.48	6.61	
ORP (mv)	-20.5	26.1	51.8	51.7	65.1	68.7	70.0	73.7	
Turbidity (NTU)	64.3	49.5	32.0	25.5	13.9	12.2	6.99	7.77	
Water Level (ft)	3.59	3.62	3.95	3.75	4.41	4.45	4.40	4.33	
Pump Rate (L/min)	2.5	2.5	2.5	3.5	3.5	3.5	3.5	3.5	
Volume (L)	1.25	2.5	5.0	8.5	12.0	12.75	14.5	14.25	

Sampling

Date: 6-19-12 Time: 1635 Method: Bladder Pump

Analyte	Method	Container	Preservation	Lab
VOC	SW846 8260B	3 x 40 ml vial	HCL	Accutest
MEE	RSK 175	3 x 40 ml vial	HCL	Accutest
TOC	9060	2 x 40 ml vial	HCL	Accutest
Sulfide	376.1	1 x 250 ml plastic	zinc acetate, sodium hydroxide	Accutest
Chl, SO4	300	1 x 250 ml plastic	4° C	Accutest
Diss Fe, Mn	6010B	1 x 500 ml plastic	4° C	Accutest
NO2, NO3, Alk	354.1, 353.2, 310.1	1 x 500 ml plastic	4° C	Accutest

Notes:

**FORMER SELLER-GLOBE FACILITY
3200 MAIN STREET, KEOKUK, IA
2011 GW MONITORING
DATA VERIFICATION REPORT**

Laboratory: Accutest
Data Package Number: TC10967
Reviewer: Joel Corley
Peer Reviewer: Sheri Fling
Date of Review Completion: July 26, 2012

This review was conducted in accordance with the Quality Assurance Project Plan (QAPP) for the Facility at 3200 Main Street Keokuk, Iowa (URSGWC, July 1999). Nine aqueous samples were submitted for analysis. The review consisted of evaluation of sample-specific criteria for volatile organic compounds (VOCs); methane, ethane, ethane (MEE); dissolved metals, iron, manganese; chloride and sulfate; nitrate and nitrite; alkalinity; sulfide; and TOC as described in the QAPP. Quality Control (QC) limits specified in the QAPP were utilized as guidance during VOC data validation; however laboratory derived limits were used to evaluate performance for the purpose of adding qualifiers for all parameters as these were not given in the QAPP. Guidelines from EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and the analytical method specifications were used as guidance during data validation. If the QAPP, analytical method, and Functional Guidelines did not specify requirements related to the criterion under evaluation, the data reviewer utilized professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment are described in the data validation review narrative. The scope of the review has included evaluation of the sample management process, blank information, QA/QC results, and assessment of any laboratory parameter issues identified in the data package case narrative. The scope of the review did not include a detailed review of calibration information, compound identification or quantification, or checking for transcription or calculation errors. The following analytical reference methods were used:

Analytical Reference Method	Analysis
SW846 Method 8260B	VOCs
RSK-175	Methane, Ethane and Ethene
SW846 Method 6010B	Dissolved metals, Iron and Manganese*
EPA 300.0/9056	Chloride and Sulfate
EPA 353.2	Nitrate and Nitrite
SM 2320B	Alkalinity
SM 4500S+F	Sulfide
SM 5310B	TOC

SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

SM - Standard Method

EPA - Environmental Protection Agency

TOC - Total Organic Carbon

* - All samples for dissolved iron and manganese were filtered in the laboratory

Table 1 lists the samples reported in this data package. Table 2 presents the results of the review of sample-specific parameters and the associated details. If review of any laboratory parameters was necessary, the associated details are included in Table 2.

Table 1 – Sample Identification and Analysis Cross-Reference

Field ID	Lab ID	Sampling Date	QC Designations
MW-16	TC10967-1	6/19/2012	SA
MW-16 Filtered	TC10967-1F	6/19/2012	SA
MW-17A	TC10967-2	6/19/2012	SA
MW-17A Filtered	TC10967-2F	6/19/2012	SA
MW-17B	TC10967-3	6/19/2012	SA/MS ¹
MW-17B Filtered	TC10967-3F	6/19/2012	SA
MW-17B DUP	TC10967-4	6/19/2012	FD
MW-17B DUP Filtered	TC10967-4F	6/19/2012	FD
EB-23B	TC10967-5	6/19/2012	EB
Trip Blank-001	TC10967-6	6/19/2012	TB

ID = Identification

FD = Field duplicate

MSD = Matrix Spike Duplicate

TB = Trip Blank

SA = Sample

MS = Matrix Spike

EB = Equipment Blank

MS¹ = Methane, Ethane, Ethene

General Usability Statement:

- ☐ Data are usable without qualification.
- ☒ Data are usable with qualification (noted below).
- ☐ Some or all data are unusable for any purpose (detailed below).

Case Narrative Summary: All site-specific samples reported in this sample delivery group were analyzed within holding time requirements and the laboratory quality control criteria were met for all quality control samples.

Table 2 – Sample Specific Data Review Summary

Review Parameters	QAPP Criteria Met?	Comments
Accuracy Evaluation		
Method blanks?	Yes	No contaminants were found in method blanks.
Surrogate recoveries?	Yes	Laboratory-derived acceptance criteria were used by the laboratory to evaluate volatile organic compound (VOC) surrogate recoveries rather than the acceptance range presented in the QAPP (76-115%). However, all surrogate recoveries were within laboratory-derived and QAPP acceptance criteria.
VOCs only		

Review Parameters	QAPP Criteria Met?	Comments
LCS recoveries?	Yes	All recoveries were within the QAPP limits for VOCs and within laboratory control limits for all other parameters.
Matrix spike recoveries?	Yes.	<p>MS/MSD samples were collected at the QAPP required frequency of 1:20 samples. The non-site specific MS/MSDs reported in this data package were not used to assess matrix performance. Per the QAPP the samples affected by MS/MSD recoveries outside evaluation criteria are the MS analytes in the parent sample and field duplicate only.</p> <p><u>VOCs</u> A site-specific MS/MSD was performed on sample MW-16. The MS/MSD recoveries and RPDs met QAPP (56-145% and <20% RPD) and laboratory quality control criteria.</p> <p><u>Dissolved Metals</u> A site-specific MS/MSD was conducted on sample MW-16. However, as the parent sample result was greater than four times the spike amount added, the MS/MSD results are not applicable for assessing accuracy and precision.</p> <p><u>Inorganics and Dissolved Gases</u> A site-specific matrix spike analysis was performed for alkalinity, chloride, nitrogen-nitrate, nitrogen-nitrite, sulfate, and sulfide, on MW-16. A matrix spike was also performed for methane, ethane, and ethene on sample MW-17B.</p> <p><u>TOC</u> A site-specific MS was conducted on sample MW-16-2011. The MS recovery for TOC was within the laboratory acceptance limits.</p>
Serial Dilution	Yes	A site-specific sample reported in another data package (10984) was used for the serial dilution. The serial dilution was carried out according to QAPP requirements for MS/MSDs spike recoveries.
Trip Blank Evaluation? VOCs only	Yes	The trip blanks were free from detectable contamination.
Equipment Blank Evaluation? VOCs only	Yes	The equipment blank was free from detectable contamination.

Review Parameters	QAPP Criteria Met?	Comments
Precision Evaluation		
Laboratory duplicate criteria met?	Yes	<p>The laboratory performed a duplicate analysis for methane, ethane, and ethane, alkalinity, chloride, nitrogen-nitrate, nitrogen-nitrite, sulfate, sulfide, and total organic carbon (TOC) on sample MW-16. The RPDs were within the laboratory acceptance limits.</p> <p>In, addition, all RPDs between the MS/MSDs were within the applicable acceptance criteria.</p>
Representativeness Evaluation		
Analyses completed within holding time limits?	Yes	All samples were analyzed within the holding time requirements.
Were sample preservation requirements met?	Yes	
Field duplicate evaluation criteria met? <ul style="list-style-type: none"> MW-17B 	No	<p>With the two exceptions, the following applicable concentration dependent criterion were met for the field duplicate pair (MW-17B/MW-17B DUP)</p> <ul style="list-style-type: none"> If both results are great than 5x times the RL, RPD <30% If the result for one or both analytes of the field duplicate pair is < 5x RL, satisfactory precision is indicated if the absolute difference between the field duplicate results is < 2x RL. <p>Methane and alkalinity did not meet field duplicate evaluation criteria for relative percent difference of < 30 (with respective RPDs of 42.4 and 33.6).</p>
Comparability Evaluation		
Are accuracy criteria met?	Yes	This was evaluated using the LCS, MS/MSD and surrogate recoveries. In general, acceptable accuracy was attained with respect to the analytical method and sample matrix.
Are precision criteria met?	No	<p>This was evaluated using the field duplicate pair and MS/MSD pairs. The MS and MSD results satisfied the precision evaluation criteria. Two data qualifiers were assigned to reflect the imprecision in field duplicates (alkalinity and methane).</p> <p>Please reference Table 3 for resultant qualification.</p>

Review Parameters	QAPP Criteria Met?	Comments												
Are measurement units and collection, analysis, and reporting methods consistent?	No	Sample analyses for 8260B and RSKSOP-147/175 are reported using mg/L. Laboratory QC samples are reported using ug/L. All other analyses have sample results and QC results reported in the same units.												
Completeness Evaluation														
Sample receipt completeness?	Yes	The samples were received by Accutest in good condition and were consistent with the accompanying chain-of-custody form (COC). The cooler temperature upon receipt at the Accutest Houston laboratory was 4.6°; within the recommended (40 CFR Part 136 < 6 degrees Celcius (°C)).												
Were results received for all samples?	Yes													
Are any data qualified as unusable?	No													
Sensitivity Evaluation														
Were project-required RLs obtained?	Yes	<p>There are no instances of non-detectable results with elevated reporting limits in this data set. Only detectable concentrations were reported for all results reported from dilutions.</p> <p>Trace level detections, reported between the method detection limit (MDL) and the reporting limit (RL) have been qualified as estimated (J).</p> <table border="1"> <thead> <tr> <th>Sampling ID</th><th>Parameter</th><th>Analyte</th><th>Qualification</th></tr> </thead> <tbody> <tr> <td>MW-17B</td><td>8260B</td><td>Vinyl Chloride</td><td>J</td></tr> <tr> <td>MW-17B-DUP</td><td>8260B</td><td>Vinyl Chloride</td><td>J</td></tr> </tbody> </table>	Sampling ID	Parameter	Analyte	Qualification	MW-17B	8260B	Vinyl Chloride	J	MW-17B-DUP	8260B	Vinyl Chloride	J
Sampling ID	Parameter	Analyte	Qualification											
MW-17B	8260B	Vinyl Chloride	J											
MW-17B-DUP	8260B	Vinyl Chloride	J											
Review of Laboratory Performance Parameters														
Instrument tuning?	NR													
Initial calibration?	NR													
Continuing calibration?	NR													
Compound identification?	NR													
Compound quantitation?	NR													
TIC evaluation?	NA													

Review Parameters	QAPP Criteria Met?	Comments
Laboratory assigned qualifiers?	Yes	

% = Percent

< = Less than

C = Celsius

COC = Chain of Custody

J = Estimated detected

LCS = Laboratory Control Sample

mg/L = milligrams per Liter

MS = Matrix Spike

MSD = Matrix Spike Duplicate

NA = Not Applicable

NR = Not Required

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

QC = Quality Control

RL = Reporting Limit

RPD = Relative Percent Difference

SDG = Sample Delivery Group

TOC = Total Organic Carbon

ug/L = micrograms per Liter

UJ = Estimated nondetect

VOC = Volatile Organic Compounds

Table 3-Field Duplicate Qualification

Sampling ID	Duplicate ID	Parameter	Analyte	Qualification
MW-17	MW-17B	RSK-175	Methane	J
		2320	Alkalinity	J

ID = Identification

**FORMER SELLER-GLOBE FACILITY
3200 MAINT STREET, KEOKUK, IOWA
2012 GROUNDWATER MONITORING
DATA VERIFICATION REPORT**

Laboratory: Accutest
Data Package Numbers: T710984
Reviewer: Joel Corley
Peer Reviewer: Sheri Fling
Date Review Completed: July 26, 2012

This review was conducted in accordance with the Quality Assurance Project Plan (QAPP) for the Facility at 3200 Main Street Keokuk, Iowa (URSGWC, July 1999). Four aqueous samples and one trip blank were submitted for analysis. The review consisted of evaluation of sample-specific criteria for volatile organic compounds (VOCs); methane, ethane, ethane (MEE); dissolved metals, iron, manganese; chloride and sulfate; nitrate and nitrite; alkalinity; sulfide; and TOC as described in the QAPP. Quality Control (QC) limits specified in the QAPP were utilized as guidance during VOC data validation; however laboratory derived limits were used to evaluate performance for the purpose of adding qualifiers for all parameters as these were not given in the QAPP. Guidelines from EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and the analytical method specifications were used as guidance during data validation. If the QAPP, analytical method, and Functional Guidelines did not specify requirements related to the criterion under evaluation, the data reviewer utilized professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment are described in the data validation review narrative. The scope of the review has included evaluation of the sample management process, blank information, QA/QC results, and assessment of any laboratory parameter issues identified in the data package case narrative. The scope of the review did not include a detailed review of calibration information, compound identification or quantification, or checking for transcription or calculation errors. The following analytical reference methods were used:

Analytical Reference Method	Analysis
SW846 Method 8260B	VOCs
RSK-175	Methane, Ethane and Ethene
SW846 Method 6010B	Dissolved metals, Iron and Manganese*
EPA 300.0/9056	Chloride and Sulfate
EPA 353.2	Nitrate and Nitrite
SM 2320B	Alkalinity
SM 4500S+F	Sulfide
SM 5310B	TOC

SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

SM - Standard Method

EPA - Environmental Protection Agency

TOC - Total Organic Carbon

* - All samples for dissolved iron and manganese were filtered in the laboratory

Table 1 lists the samples reported in this data package. Table 2 presents the results of the review of sample-specific parameters and the associated details. If review of any laboratory parameters was necessary, the associated details are included in Table 2.

Table 1 – Sample Identification and Analysis Cross-Reference

Field ID	Lab ID	Sampling Date	QC Designations
MW-19	TC10984-1	6/19/2012	SA/MS ¹
MW-19	TC10984-1F	6/19/2012	SA/MS ²
MW-23A	TC10984-2	6/19/2012	SA
MW-23A	TC10984-2F	6/19/2012	SA
MW-23B	TC10984-3	6/19/2012	SA
MW-23B	TC10984-3F	6/19/2012	SA
TRIP BLANK-002	TC10984-4	6/19/2012	TB

SA = Sample

FD = Field duplicate

MS = Matrix Spike

TB = Trip Blank

EB = Equipment Blank

MSD = Matrix Spike Duplicate

MS¹ = Volatile organic compounds; methane, ethane, ethane; alkalinity; nitrogen-nitrate, nitrogen-nitrite; sulfate; total organic carbon

MS² = metals

General Usability Statement:

- ☐ Data are usable without qualification.
- ☒ Data are usable with qualification (noted below).
- ☐ Some or all data are unusable for any purpose (detailed below).

Case Narrative Summary: It was indicated in the laboratory case narrative that all samples reported in this sample delivery group were analyzed within holding time requirements and the laboratory quality control criteria were met for all quality control samples.

Table 2 – Sample Specific Data Review Summary

Review Parameters	QAPP Criteria Met?	Comments
Accuracy Evaluation		
Method blanks?	Yes	No contaminants were detected in method blanks; therefore, qualification of data was not required.
Surrogate recoveries?	Yes	Laboratory-derived acceptance criteria were used by the laboratory to evaluate volatile organic compound (VOC) surrogate recoveries rather than the acceptance range presented in the QAPP (76-115%) since the laboratory-derived limits were tighter. However, all surrogate recoveries were within laboratory-derived and QAPP acceptance criteria.
VOCs only		

Review Parameters	QAPP Criteria Met?	Comments
LCS recoveries?	Yes	All recoveries were within the QAPP limits for VOCs and within laboratory control limits for all other parameters.
Matrix spike recoveries?	Yes	<p>MS/MSD samples were collected at the QAPP required frequency of 1:20 samples. The non-site specific MS/MSDs reported in this data package were not used to assess matrix performance. Per the QAPP the samples affected by MS/MSD recoveries outside evaluation criteria are the MS analytes in the parent sample and field duplicate only.</p> <p><u>VOCs</u> A site-specific MS/MSD was performed on sample MW-19. The MS/MSD recoveries and RPDs met QAPP (56-145% and <20% RPD) and laboratory quality control criteria.</p> <p><u>Dissolved Metals</u> A site-specific MS/MSD was conducted on sample MW-19.</p> <p>The MS/MSD recovery for metals analysis met laboratory quality control criteria.</p> <p><u>Inorganics</u> A site-specific MS was performed for alkalinity, chloride, nitrogen-nitrate, nitrogen-nitrite, and sulfate on MW-19.</p> <p><u>Total Organic Carbon (TOC)</u> A site-specific MS was conducted on sample MW-19 for TOC. The MS recovery for TOC on sample MW-19 met laboratory quality control criteria.</p> <p><u>Dissolved Gas</u> A site-specific MS was conducted on sample MW-19 for dissolved gases. The MS recovery for dissolved gas analysis on sample MW-19 met laboratory quality control criteria.</p>
Serial Dilution (Dilution Test)	Yes	<p>A serial dilution was performed on sample MW-19. Only the results that were greater than 50 times their respective instrument detection limits (IDLs) are appropriate for comparison to the evaluation criterion. Therefore, the dilution test cannot be evaluated down to the IDL for iron on sample MW-19. Manganese was within the method acceptance criteria (<10 percent difference).</p> <p>No further action is considered necessary.</p>

Review Parameters	QAPP Criteria Met?	Comments
Trip Blank Evaluation? VOCs only	Yes	The trip blank was free from detectable contamination.
Equipment Blank Evaluation? VOCs only	Not Applicable	No equipment blank sample was submitted for analysis.
Precision Evaluation		
Laboratory duplicate criteria met?	Yes	No site-specific samples were selected by the laboratory for duplicate analysis. The RPDs between the MS/MSDs for duplicate measurements (regular laboratory duplicates and spiked duplicates) were within the applicable acceptance criteria for VOCs and metals.
Representativeness Evaluation		
Analyses completed within holding time limits?	Yes	All samples were analyzed within the holding time requirements.
Were sample preservation requirements met?	Yes	
Field duplicate evaluation criteria met?	Not Applicable	A field duplicate was not collected and reported in this SDG. However, field duplicates were collected and reported with other site SDGs and were analyzed at the QAPP-specified frequency, 1:20.
Comparability Evaluation		
Are accuracy criteria met?	Yes	This was evaluated using the LCS, MS/MSD and surrogate recoveries. In general, acceptable accuracy was attained with respect to the analytical method and sample matrix.
Are precision criteria met?	Yes	This was evaluated using the laboratory duplicate pairs and MS/MSD pairs. The laboratory duplicate pairs MS and MSD results satisfied the precision evaluation criteria.

Review Parameters	QAPP Criteria Met?	Comments
Are measurement units and collection, analysis, and reporting methods consistent?	Yes	Sample analyses for 8260B and RSKSOP-147/175 are reported using mg/L. Laboratory QC samples are reported using ug/L. All other analyses have sample results and QC results reported in the same units.
Completeness Evaluation		
Sample receipt completeness?	Yes	The samples were received by Accutest in good condition and were consistent with the accompanying chain-of-custody form (COC). The cooler temperature upon receipt at the Accutest Houston laboratory was 5.5 degrees Celsius (°C), within the recommended < 6 °C temperature (40 CFR Part 136).
Were results received for all samples?	Yes	
Are any data qualified as unusable?	Yes	Carbon tetrachloride detected in MW-19 and its corresponding MS/MSD were qualified J as a numerical approximation. No further explanation is given, and all criterion appear to have been met.
Sensitivity Evaluation		
Were project-required RLs obtained?	Yes	There are no instances of non-detectable results with elevated reporting limits in this data set. Detectable concentrations were reported for all results reported from dilutions. Trace level detections, reported between the method detection limit (MDL) and the reporting limit (RL) have been qualified as estimated (J).
Review of Laboratory Performance Parameters		
Instrument tuning?	NR	
Initial calibration?	NR	
Continuing calibration?	NR	
Compound identification?	NR	
Compound quantitation?	NR	
TIC evaluation?	NA	
Laboratory assigned qualifiers?	Yes	

% = Percent

< = Less than

C = Celsius

COC = Chain of Custody

J = Estimated detected

LCS = Laboratory Control Sample

mg/L = milligrams per Liter

MS = Matrix Spike

MSD = Matrix Spike Duplicate

NA = Not Applicable

NR = Not Required

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

QC = Quality Control

RL = Reporting Limit

RPD = Relative Percent Difference

SDG = Sample Delivery Group

TOC = Total Organic Carbon

ug/L = micrograms per Liter

UJ = Estimated nondetect

VOC = Volatile Organic Compounds

**FORMER SELLER-GLOBE FACILITY
3200 MAIN STREET, KEOKUK, IOWA
2012 GROUNDWATER
DATA VERIFICATION REPORT**

Laboratory: Accutest
Data Package Numbers: TC11086
Reviewer: Joel Corley
Peer Reviewer: Sheri Fling
Date Review Completed: July 26, 2012

This review was conducted in accordance with the Quality Assurance Project Plan (QAPP) for the Facility at 3200 Main Street Keokuk, Iowa (URSGWC, July 1999). Five aqueous samples and one trip blank were submitted for analysis. The review consisted of evaluation of sample-specific criteria for volatile organic compounds (VOCs); methane, ethane, ethane (MEE); dissolved metals, iron, manganese; chloride and sulfate; nitrate and nitrite; alkalinity; sulfide; and TOC as described in the QAPP. Quality Control (QC) limits specified in the QAPP were utilized as guidance during VOC data validation; however laboratory derived limits were used to evaluate performance for the purpose of adding qualifiers for all parameters as these were not given in the QAPP. Guidelines from EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and the analytical method specifications were used as guidance during data validation. If the QAPP, analytical method, and Functional Guidelines did not specify requirements related to the criterion under evaluation, the data reviewer utilized professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment are described in the data validation review narrative. The scope of the review has included evaluation of the sample management process, blank information, QA/QC results, and assessment of any laboratory parameter issues identified in the data package case narrative. The scope of the review did not include a detailed review of calibration information, compound identification or quantification, or checking for transcription or calculation errors. The following analytical reference methods were used:

Analytical Reference Method	Analysis
SW846 Method 8260B	VOCs
RSK-175	Methane, Ethane and Ethene
SW846 Method 6010B	Dissolved metals, Iron and Magnesium*
EPA 300.0/9056	Chloride and Sulfate
EPA 353.2	Nitrate and Nitrite
SM 2320B	Alkalinity
SM 4500S+F	Sulfide
SM 5310B	TOC

SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

SM - Standard Method

EPA - Environmental Protection Agency

TOC - Total Organic Carbon

* - All samples for dissolved iron and magnesium were filtered in the laboratory

Table 1 lists the samples reported in this data package. Table 2 presents the results of the review of sample-specific parameters and the associated details. If review of any laboratory parameters was necessary, the associated details are included in Table 2.

Table 1 – Sample Identification and Analysis Cross-Reference

Field ID	Lab ID	Sampling Date	QC Designations
MW-6A	TC11086-1	6/20/2012	SA
MW-6A	TC11086-1F	6/20/2012	SA
MW-7	TC11086-2	6/20/2012	SA/MS ¹
MW-7	TC11086-2F	6/20/2012	SA
MW-10	TC11086-3	6/20/2012	SA
MW-10	TC11086-3F	6/20/2012	SA
MW-10A	TC11086-4	6/20/2012	SA
MW-10A	TC11086-4F	6/20/2012	SA
EB-10	TC11086-5	6/20/2012	EB
Trip Blank 004	TC11086-6	6/20/2012	TP

SA = Sample

FD = Field duplicate

MS=Matrix Spike

MSD = Matrix Spike Duplicate

TB = Trip Blank

EB = Equipment Blank

MS¹=Nitrate, Nitrite

General Usability Statement:

- ☒ Data are usable without qualification.
☐ Data are usable with qualification (noted below).
☐ Some or all data are unusable for any purpose (detailed below).

Case Narrative Summary: All site-specific samples reported in this sample delivery group were analyzed within holding time requirements and the laboratory quality control criteria were met for all quality control samples.

Table 2 – Sample Specific Data Review Summary

Review Parameters	QAPP Criteria Met?	Comments
Accuracy Evaluation		
Method blanks?	Yes	No contaminants were detected in method blanks; therefore, qualification of data was not required.
Surrogate recoveries?	Yes	Laboratory-derived acceptance criteria were used by the laboratory to evaluate volatile organic compound (VOC) surrogate recoveries rather than the acceptance range presented in the QAPP (76-115%) since the laboratory-derived limits were tighter. However, all surrogate recoveries were within laboratory-derived and QAPP acceptance criteria.
VOCs only		

Review Parameters	QAPP Criteria Met?	Comments
LCS recoveries?	Yes	All recoveries were within the QAPP limits for VOCs and within laboratory control limits for all other parameters.
Matrix spike recoveries?	Yes	<p>MS/MSD samples were collected at the QAPP required frequency of 1:20 samples. The non-site specific MS/MSDs reported in this data package were not used to assess matrix performance. Per the QAPP the samples affected by MS/MSD recoveries outside evaluation criteria are the MS analytes in the parent sample and field duplicate only.</p> <p><u>VOCs</u> No MS/MSDs were performed using site-specific VOCs for this data package.</p> <p><u>Dissolved Metals</u> No MS/MSDs were performed using site-specific dissolved metals for this data package.</p> <p><u>Inorganics</u> A site-specific matrix spike analysis was performed for -nitrate as nitrogen and nitrite as nitrogen on MW-7.</p> <p><u>TOC</u> No MS/MSDs were performed using site-specific TOC samples for this data package.</p> <p><u>Dissolved Gas</u> No MS/MSDs were performed using site-specific dissolved gases for samples within this data package.</p>
Serial Dilution Metals Only	Yes	A non-site specific sample was used for the serial dilution.
Trip Blank Evaluation? VOCs Only	Yes	The trip blank was free from detectable contamination.
Equipment Blank Evaluation?	Yes	The equipment blank was free from detectable contamination.
Precision Evaluation		
Laboratory duplicate criteria met?	Yes	The laboratory performed a duplicate analysis for nitrate, and nitrite using sample MW-7. The RPDs were within the laboratory acceptance limits.

Review Parameters	QAPP Criteria Met?	Comments
Representativeness Evaluation		
Analyses completed within holding time limits?	Yes	All samples were analyzed within the holding time requirements.
Were sample preservation requirements met?	Yes	
Field duplicate evaluation criteria met?	Not Applicable	A field duplicate was not collected and reported in this SDG. However, field duplicates were collected and reported with other sites in this sampling event and were analyzed at the QAPP-specified frequency.
Comparability Evaluation		
Are accuracy criteria met?	Yes	This was evaluated using the LCS, MS/MSD and surrogate recoveries. In general, acceptable accuracy was attained with respect to the analytical method and sample matrix.
Are precision criteria met?	Yes	This was evaluated using the laboratory duplicate pairs and MS/MSD pairs. The laboratory duplicate pairs MS and MSD results satisfied the precision evaluation criteria.
Are measurement units and collection, analysis, and reporting methods consistent?	No	Sample analyses for 8260B and RSKSOP-147/175 are reported using mg/L. Laboratory QC samples are reported using ug/L. All other analyses have sample results and QC results reported in the same units.
Completeness Evaluation		
Sample receipt completeness?	Yes	The samples were received by Accutest in good condition and were consistent with the accompanying chain-of-custody form (COC). The cooler temperatures upon receipt at the Accutest Houston laboratory was 2.2 degrees Celsius (°C); within the recommended < 6 °C temperature (40 CFR Part 136).
Were results received for all samples?	Yes	
Are any data qualified as unusable?	Yes	
Sensitivity Evaluation		
Were project-required RLs obtained?	Yes	There are no instances of non-detectable results with elevated reporting limits in this data set. Detectable concentrations were reported for all results reported from dilutions.

Review Parameters	QAPP Criteria Met?	Comments																										
		<p>Several analytes had detectable concentrations above the Method Detection Limit (MDL), however, these fell below the Reporting Limit (RL); as a result they were qualified as J, a numerical approximation. These analytes are listed in the table below.</p> <table><tr><th>Sampling ID</th><th>Parameter</th><th>Analyte</th><th>Qualification</th></tr><tr><td rowspan="2">MW-7</td><td rowspan="2">8260B</td><td>1,1-Dichloroethane</td><td>J</td></tr><tr><td>1,2-Dichloroethane</td><td>J</td></tr><tr><td rowspan="3">MW-10</td><td rowspan="3">8260B</td><td>Benzene</td><td>J</td></tr><tr><td>Carbon disulfide</td><td>J</td></tr><tr><td>trans-1,2-Dichloroethylene</td><td>J</td></tr><tr><td rowspan="3">MW-10A</td><td rowspan="3">8260B</td><td>Benzene</td><td>J</td></tr><tr><td>1,2-Dichloroethene (total)</td><td>J</td></tr><tr><td>Vinyl chloride</td><td>J</td></tr></table>	Sampling ID	Parameter	Analyte	Qualification	MW-7	8260B	1,1-Dichloroethane	J	1,2-Dichloroethane	J	MW-10	8260B	Benzene	J	Carbon disulfide	J	trans-1,2-Dichloroethylene	J	MW-10A	8260B	Benzene	J	1,2-Dichloroethene (total)	J	Vinyl chloride	J
Sampling ID	Parameter	Analyte	Qualification																									
MW-7	8260B	1,1-Dichloroethane	J																									
		1,2-Dichloroethane	J																									
MW-10	8260B	Benzene	J																									
		Carbon disulfide	J																									
		trans-1,2-Dichloroethylene	J																									
MW-10A	8260B	Benzene	J																									
		1,2-Dichloroethene (total)	J																									
		Vinyl chloride	J																									

Review of Laboratory Performance Parameters

Instrument tuning?	NR	
Initial calibration?	NR	
Continuing calibration?	NR	
Compound identification?	NR	
Compound quantitation?	NR	
TIC evaluation?	NA	
Laboratory assigned qualifiers?	Yes	

% = Percent

< = Less than

C = Celsius

COC = Chain of Custody

J = Estimated detected

LCS = Laboratory Control Sample

mg/L = milligrams per Liter

MS = Matrix Spike

MSD = Matrix Spike Duplicate

NA = Not Applicable

NR = Not Required

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

QC = Quality Control

RL = Reporting Limit

RPD = Relative Percent Difference

SDG = Sample Delivery Group

TOC = Total Organic Carbon

ug/L = micrograms per Liter

UJ = Estimated nondetect

VOC = Volatile Organic Compounds

**FORMER SHELLER-GLOB FACILITY
3200 MAIN STREET, KEOKUK, IOWA
2012 GROUNDWATER MONITORING
DATA VERIFICATION REPORT**

Laboratory: Accutest
Data Package Numbers: T711103
Reviewer: Joel Corley
Peer Reviewer: Sheri Fling
Date Review Completed: July 26, 2012

This review was conducted in accordance with the Quality Assurance Project Plan (QAPP) for the Facility at 3200 Main Street Keokuk, Iowa (URSGWC, July 1999). Four aqueous samples were submitted for analysis. The review consisted of evaluation of sample-specific criteria for volatile organic compounds (VOCs); methane, ethane, ethane (MEE); dissolved metals, iron, manganese; chloride and sulfate; nitrate and nitrite; alkalinity; sulfide; and TOC as described in the QAPP. Quality Control (QC) limits specified in the QAPP were utilized as guidance during VOC data validation; however laboratory derived limits were used to evaluate performance for the purpose of adding qualifiers for all parameters as these were not given in the QAPP. Guidelines from EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and the analytical method specifications were used as guidance during data validation. If the QAPP, analytical method, and Functional Guidelines did not specify requirements related to the criterion under evaluation, the data reviewer utilized professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment are described in the data validation review narrative. The scope of the review has included evaluation of the sample management process, blank information, QA/QC results, and assessment of any laboratory parameter issues identified in the data package case narrative. The scope of the review did not include a detailed review of calibration information, compound identification or quantification, or checking for transcription or calculation errors. The following analytical reference methods were used:

Analytical Reference Method	Analysis
SW846 Method 8260B	VOCs
RSK-175	Methane, Ethane and Ethene
SW846 Method 6010B	Dissolved metals, Iron and Magnesium*
EPA 300.0/9056	Chloride and Sulfate
EPA 353.2	Nitrate and Nitrite
SM 2320B	Alkalinity
SM 4500S+F	Sulfide
SM 5310B	TOC

SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

SM - Standard Method

EPA - Environmental Protection Agency

TOC - Total Organic Carbon

* - All samples for dissolved iron and magnesium were filtered in the laboratory

Table 1 lists the samples reported in this data package. Table 2 presents the results of the review of sample-specific parameters and the associated details. If review of any laboratory parameters was necessary, the associated details are included in Table 2.

Table 1 – Sample Identification and Analysis Cross-Reference

Field ID	Lab ID	Sampling Date	QC Designations
MW-20	TC11103-1	6/20/2012	SA/MS ¹ /MS/MSD ²
MW-20	TC11103-1F	6/21/2012	SA
MW-1	TC11103-2	6/22/2012	SA
MW-1	TC11103-2F	6/23/2012	SA
MW-2R	TC11103-3	6/24/2012	SA
MW-2R	TC11103-3F	6/25/2012	SA
MW-3	TC11103-4	6/26/2012	SA
MW-3	TC11103-4F	6/27/2012	SA
BLANK-003	TC11103-5	6/28/2012	TB

SA = Sample

FD = Field duplicate

MS = Matrix Spike

MSD = Matrix Spike Duplicate

TB = Trip Blank

EB = Equipment Blank

VOCs = Volatile Organic Compounds

MS¹ - Nitrogen-Nitrate, Nitrogen-Nitrite

MS/MSD² - VOCs

General Usability Statement:

- ☒ Data are usable without qualification.
☐ Data are usable with qualification (noted below).
☐ Some or all data are unusable for any purpose (detailed below).

Case Narrative Summary: It was indicated in the laboratory case narrative that all samples reported in this sample delivery group were analyzed within holding time requirements and the laboratory quality control criteria were met for all quality control samples.

Table 2 – Sample Specific Data Review Summary

Review Parameters	QAPP Criteria Met?	Comments
Accuracy Evaluation		
Method blanks?	No	With one exception, no target analytes were detected in the method blank. Hexane was found in the VOC method blank at 0.72 ug/L. Hexane was not detected in associated samples; therefore, qualification of data was not required.
Surrogate recoveries? VOCs only	Yes	Laboratory-derived acceptance criteria were used by the laboratory to evaluate volatile organic compound (VOC) surrogate recoveries rather than the acceptance range presented in the QAPP(76-115%). However, all surrogate recoveries were within laboratory-derived and QAPP acceptance criteria.

Review Parameters	QAPP Criteria Met?	Comments
LCS recoveries?	Yes	All recoveries were within the QAPP limits for VOCs within laboratory control limits for all other parameters.
Matrix spike recoveries?	Yes	<p>MS/MSD samples were collected at the QAPP required frequency of 1:20 samples. The non-site specific MS/MSDs reported in this data package were not used to assess matrix performance. Per the QAPP the samples affected by MS/MSD recoveries outside evaluation criteria are the MS analytes in the parent sample and field duplicate only.</p> <p><u>VOCs</u> A site-specific MS/MSD was performed on sample MW-20. The MS/MSD recoveries and RPDs met QAPP (56-145% and <20% RPD) and laboratory quality control criteria.</p> <p><u>Dissolved Metals</u> No site-specific MS/MSD recovery analysis was carried out for metals.</p> <p><u>Inorganics</u> MW-20 The MS/MSD recovery for nitrogen-nitrate, and nitrogen-nitrite met laboratory quality control criteria. A site-specific matrix spike analysis was performed nitrogen-nitrate and nitrogen-nitrite on MW-20.</p> <p><u>TOC</u> No site-specific MS/MSD recovery analysis was carried out for TOC.</p> <p><u>Dissolved Gas</u> No site-specific MS/MSD recovery analysis was performed for dissolved gas.</p>
Serial Dilution Metals only	Yes	A non-site specific sample was used for the serial dilution. The serial dilution was carried out according to QAPP requirements for MS/MSDs spike recoveries.
Trip Blank Evaluation? VOCs only	Yes	The trip blank was free from detectable contamination.
Equipment Blank Evaluation?	Not Applicable	The equipment blank sample was not submitted for analysis.

Review Parameters	QAPP Criteria Met?	Comments
Precision Evaluation		
Laboratory duplicate criteria met?	Yes	The laboratory performed a duplicate analysis of a site-specific sample for nitrogen-nitrate, and nitrogen-nitrite using sample MW-20. All RPDs for duplicate measurements (regular laboratory duplicates and spiked duplicates) were within acceptance criteria.
Representativeness Evaluation		
Analyses completed within holding time limits?	Yes	All samples were analyzed within the holding time requirements.
Were sample preservation requirements met?	Yes	
Field duplicate evaluation criteria met?	Not Applicable	A field duplicate was not collected and reported in this SDG. However, field duplicates were collected and reported with other site SDGs and were analyzed at the QAPP-specified frequency, 1:20.
Comparability Evaluation		
Are accuracy criteria met?	Yes	This was evaluated using the LCS, MS/MSD and surrogate recoveries. In general, acceptable accuracy was attained with respect to the analytical method and sample matrix.
Are precision criteria met?	Yes	This was evaluated using the laboratory duplicate pairs and MS/MSD pairs. The laboratory duplicate pairs MS and MSD results satisfied the precision evaluation criteria.
Are measurement units and collection, analysis, and reporting methods consistent?	No	Sample analyses for 8260B and RSKSOP-147/175 are reported using mg/L. Laboratory QC samples are reported using ug/L. All other analyses have sample results and QC results reported in the same units.
Completeness Evaluation		
Sample receipt completeness?	No	The samples were received by Accutest in good condition and were consistent with the accompanying chain-of-custody form (COC). The cooler temperature upon receipt at the Accutest Houston laboratory was 3.6 degrees Celsius (°C); within the recommended < 6 °C temperature (40 CFR Part 136).
Were results received for all samples?	Yes	
Are any data qualified as unusable?	No	

Review Parameters	QAPP Criteria Met?	Comments
Sensitivity Evaluation		
Were project-required RLs obtained?	Yes	There are no instances of non-detectable results with elevated reporting limits in this data set. Only detectable concentrations were reported for all results reported from dilutions. Trace level detections, reported between the method detection limit (MDL) and the reporting limit (RL) have been qualified as estimated (J).
Review of Laboratory Performance Parameters		
Instrument tuning?	NR	
Initial calibration?	NR	
Continuing calibration?	NR	
Compound identification?	NR	
Compound quantitation?	NR	
TIC evaluation?	NA	
Laboratory assigned qualifiers?	Yes	

% = Percent

< = Less than

C = Celsius

COC = Chain of Custody

J = Estimated detected

LCS = Laboratory Control Sample

mg/L = milligrams per Liter

MS = Matrix Spike

MSD = Matrix Spike Duplicate

NA = Not Applicable

NR = Not Required

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

QC = Quality Control

RL = Reporting Limit

RPD = Relative Percent Difference

SDG = Sample Delivery Group

TOC = Total Organic Carbon

ug/L = micrograms per Liter

UJ = Estimated nondetect

VOC = Volatile Organic Compounds

**FORMER SELLER-GLOBE FACILITY
3200 MAINT STREET, KEOKUK, IOWA
2012 GROUNDWATER
DATA VERIFICATION REPORT**

Laboratory: Accutest
Data Package Numbers: TC11159
Reviewer: Joel Corley
Peer Reviewer: Sheri Fling
Date Review Completed: July 26, 2012

This review was conducted in accordance with the Quality Assurance Project Plan (QAPP) for the Facility at 3200 Main Street Keokuk, Iowa (URSGWC, July 1999). Five aqueous samples and one trip blank were submitted for analysis. The review consisted of evaluation of sample-specific criteria for volatile organic compounds (VOCs); methane, ethane, ethane (MEE); dissolved metals, iron, manganese; chloride and sulfate; nitrate and nitrite; alkalinity; sulfide; and TOC as described in the QAPP. Quality Control (QC) limits specified in the QAPP were utilized as guidance during VOC data validation; however laboratory derived limits were used to evaluate performance for the purpose of adding qualifiers for all parameters as these were not given in the QAPP. Guidelines from EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and the analytical method specifications were used as guidance during data validation. If the QAPP, analytical method, and Functional Guidelines did not specify requirements related to the criterion under evaluation, the data reviewer utilized professional judgment to evaluate the effect of the reported item or condition on the associated analytical data. All uses of professional judgment are described in the data validation review narrative. The scope of the review has included evaluation of the sample management process, blank information, QA/QC results, and assessment of any laboratory parameter issues identified in the data package case narrative. The scope of the review did not include a detailed review of calibration information, compound identification or quantification, or checking for transcription or calculation errors. The following analytical reference methods were used:

Analytical Reference Method	Analysis
SW846 Method 8260B	VOCs
RSK-175	Methane, Ethane and Ethene
SW846 Method 6010B	Dissolved metals, Iron and Magnesium*
EPA 300.0/9056	Chloride and Sulfate
EPA 353.2	Nitrate and Nitrite
SM 2320B	Alkalinity
SM 4500S+F	Sulfide
SM 5310B	TOC

SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

SM - Standard Method

EPA - Environmental Protection Agency

TOC - Total Organic Carbon

* - All samples for dissolved iron and magnesium were filtered in the laboratory

Table 1 lists the samples reported in this data package. Table 2 presents the results of the review of sample-specific parameters and the associated details. If review of any laboratory parameters was necessary, the associated details are included in Table 2.

Table 1 – Sample Identification and Analysis Cross-Reference

Field ID	Lab ID	Sampling Date	QC Designations
MW-13	TC11159-1	6/21/2012	SA
MW-13	TC11159-1F	6/21/2012	SA
MW-13-DUP	TC11159-2	6/21/2012	FD
MW-13-DUP	TC11159-2F	6/21/2012	FD
MW-13A	TC11159-3	6/21/2012	SA
MW-13A	TC11159-3F	6/21/2012	SA
MW-13B	TC11159-4	6/21/2012	SA
MW-13B	TC11159-4F	6/21/2012	SA
EB-13	TC11159-5	6/21/2012	EB

SA = Sample

FD = Field duplicate

MS=Matrix Spike

MSD = Matrix Spike Duplicate

EB = Equipment Blank

General Usability Statement:

- ☒ Data are usable without qualification.
- ☐ Data are usable with qualification (noted below).
- ☐ Some or all data are unusable for any purpose (detailed below).

Case Narrative Summary: All site-specific samples reported in this sample delivery group were analyzed within holding time requirements and the laboratory quality control criteria were met for all quality control samples.

Table 2 – Sample Specific Data Review Summary

Review Parameters	QAPP Criteria Met?	Comments
Accuracy Evaluation		
Method blanks?	No	With one exception, no target analytes were detected in the method blank. Hexane was found in the VOC method blank at 0.72 ug/L. Hexane was not detected in associated samples; therefore, qualification of data was not required.
Surrogate recoveries? VOCs Only	Yes	Laboratory-derived acceptance criteria were used by the laboratory to evaluate volatile organic compound (VOC) surrogate recoveries rather than the acceptance range presented in the (QAPP) (76-115%). However, all surrogate recoveries were within laboratory-derived and QAPP acceptance criteria.
LCS recoveries?	Yes	All recoveries were within the QAPP limits for VOCs and within laboratory control limits for all other parameters.
Matrix spike recoveries?	Yes	<p>MS/MSD samples were collected at the QAPP required frequency of 1:20 samples. The non-site specific MS/MSDs reported in this data package were not used to assess matrix performance. Per the QAPP the samples affected by MS/MSD recoveries outside evaluation criteria are the MS analytes in the parent sample and field duplicate only.</p> <p><u>VOCs</u> No MS/MSDs were performed using site-specific VOCs for this data package.</p> <p><u>Dissolved Metals</u> No MS/MSDs were performed using site-specific dissolved metals for this data package.</p> <p><u>Inorganics</u> An inorganic site-specific sample was not used as a MS/MSD for this data package.</p> <p><u>TOC</u> No MS/MSDs were performed using site-specific TOC samples for this data package.</p> <p><u>Dissolved Gas</u> No MS/MSDs were performed using site-specific dissolved gases for samples within this data package.</p>
Serial Dilution Metals only	Yes	A non-site specific sample was used for the serial dilution.

Review Parameters	QAPP Criteria Met?	Comments
Trip Blank Evaluation? VOCs only	Not Applicable	A trip blank was not submitted for analysis.
Equipment Blank Evaluation?	Yes	The equipment blank sample was free from detectable contamination.
Precision Evaluation		
Laboratory duplicate criteria met?	Not Applicable	No laboratory duplicates were reported with this sample delivery group.
Representativeness Evaluation		
Analyses completed within holding time limits?	Yes	All samples were analyzed within the holding time requirements.
Were sample preservation requirements met?	Yes	
Field duplicate evaluation criteria met?	No	MW-13-DUP was collected as a field duplicate to sample MW-13 and reported in this SDG. RPDs for duplicate measurements were within QAPP acceptance criteria (< 20 RPD), except in Table 3 below.
Comparability Evaluation		
Are accuracy criteria met?	Yes	This was evaluated using the LCS, MS/MSD and surrogate recoveries. In general, acceptable accuracy was attained with respect to the analytical method and sample matrix.
Are precision criteria met?	Yes	This was evaluated using the laboratory duplicate pairs and MS/MSD pairs. The laboratory duplicate pairs MS and MSD results satisfied the precision evaluation criteria.
Are measurement units and collection, analysis, and reporting methods consistent?	No	Sample analyses for 8260B and RSKSOP-147/175 are reported using mg/L. Laboratory QC samples are reported using ug/L. All other analyses have sample results and QC results reported in the same units.
Completeness Evaluation		
Sample receipt completeness?	Yes	The samples were received by Accutest in good condition and were consistent with the accompanying chain-of-custody form (COC). The cooler temperatures upon receipt at the Accutest Houston laboratory was 4.7 degrees Celsius (°C); within the recommended < 6 °C temperature (40 CFR Part 136).
Were results received for all samples?	Yes	

Review Parameters	QAPP Criteria Met?	Comments																												
Are any data qualified as unusable?	No																													
Sensitivity Evaluation																														
Were project-required RLs obtained?	Yes	Trace level detections, reported between the method detection limit (MDL) and the reporting limit (RL) have been qualified as estimated (J). <table border="1"> <thead> <tr> <th>Sampling ID</th><th>Parameter</th><th>Analyte</th><th>Qualification</th></tr> </thead> <tbody> <tr> <td rowspan="3">MW-13</td><td rowspan="3">8260B</td><td>1,2-Dichloropropane</td><td>J</td></tr> <tr> <td>1,1,1-Trichloroethane</td><td>J</td></tr> <tr> <td>Vinyl chloride</td><td>J</td></tr> <tr> <td rowspan="3">MW-13-DUP</td><td rowspan="3">8260B</td><td>1,2-Dichloroethane</td><td>J</td></tr> <tr> <td>1,1,1-Trichloroethane</td><td>J</td></tr> <tr> <td>Vinyl chloride</td><td>J</td></tr> <tr> <td>MW-13A</td><td>8260B</td><td>Toluene</td><td>J</td></tr> <tr> <td>MW-13B</td><td>8260B</td><td>Vinyl chloride</td><td>J</td></tr> </tbody> </table>	Sampling ID	Parameter	Analyte	Qualification	MW-13	8260B	1,2-Dichloropropane	J	1,1,1-Trichloroethane	J	Vinyl chloride	J	MW-13-DUP	8260B	1,2-Dichloroethane	J	1,1,1-Trichloroethane	J	Vinyl chloride	J	MW-13A	8260B	Toluene	J	MW-13B	8260B	Vinyl chloride	J
Sampling ID	Parameter	Analyte	Qualification																											
MW-13	8260B	1,2-Dichloropropane	J																											
		1,1,1-Trichloroethane	J																											
		Vinyl chloride	J																											
MW-13-DUP	8260B	1,2-Dichloroethane	J																											
		1,1,1-Trichloroethane	J																											
		Vinyl chloride	J																											
MW-13A	8260B	Toluene	J																											
MW-13B	8260B	Vinyl chloride	J																											
Review of Laboratory Performance Parameters																														
Instrument tuning?	NR																													
Initial calibration?	NR																													
Continuing calibration?	NR																													
Compound identification?	NR																													
Compound quantitation?	NR																													
TIC evaluation?	NA																													
Laboratory assigned qualifiers?	Yes																													

% = Percent

< = Less than

C = Celsius

COC = Chain of Custody

J = Estimated detected

LCS = Laboratory Control Sample

mg/L = milligrams per Liter

MS = Matrix Spike

MSD = Matrix Spike Duplicate

NA = Not Applicable

NR = Not Required

QA = Quality Assurance

QAPP = Quality Assurance Project Plan

QC = Quality Control

RL = Reporting Limit

RPD = Relative Percent Difference

SDG = Sample Delivery Group

TOC = Total Organic Carbon

ug/L = micrograms per Liter

UJ = Estimated nondetect

VOC = Volatile Organic Compounds

Table 3-Field Duplicate Outliers

Field ID	Field Dup	Parameter	Analyte	RPD (< 20%) [If > 5xRL]	Difference (< 2xRL) [If <5xRL]	Qualification
MW-13	MW-13-Dup	8260	1,2-Dichloroethene (total)		0.026 (0.02)	J
		8260	Methylene chloride		0.57 (0.5)	J
		RSK-175	Methane	35.3		J
		6010	Iron		239 (200)	J

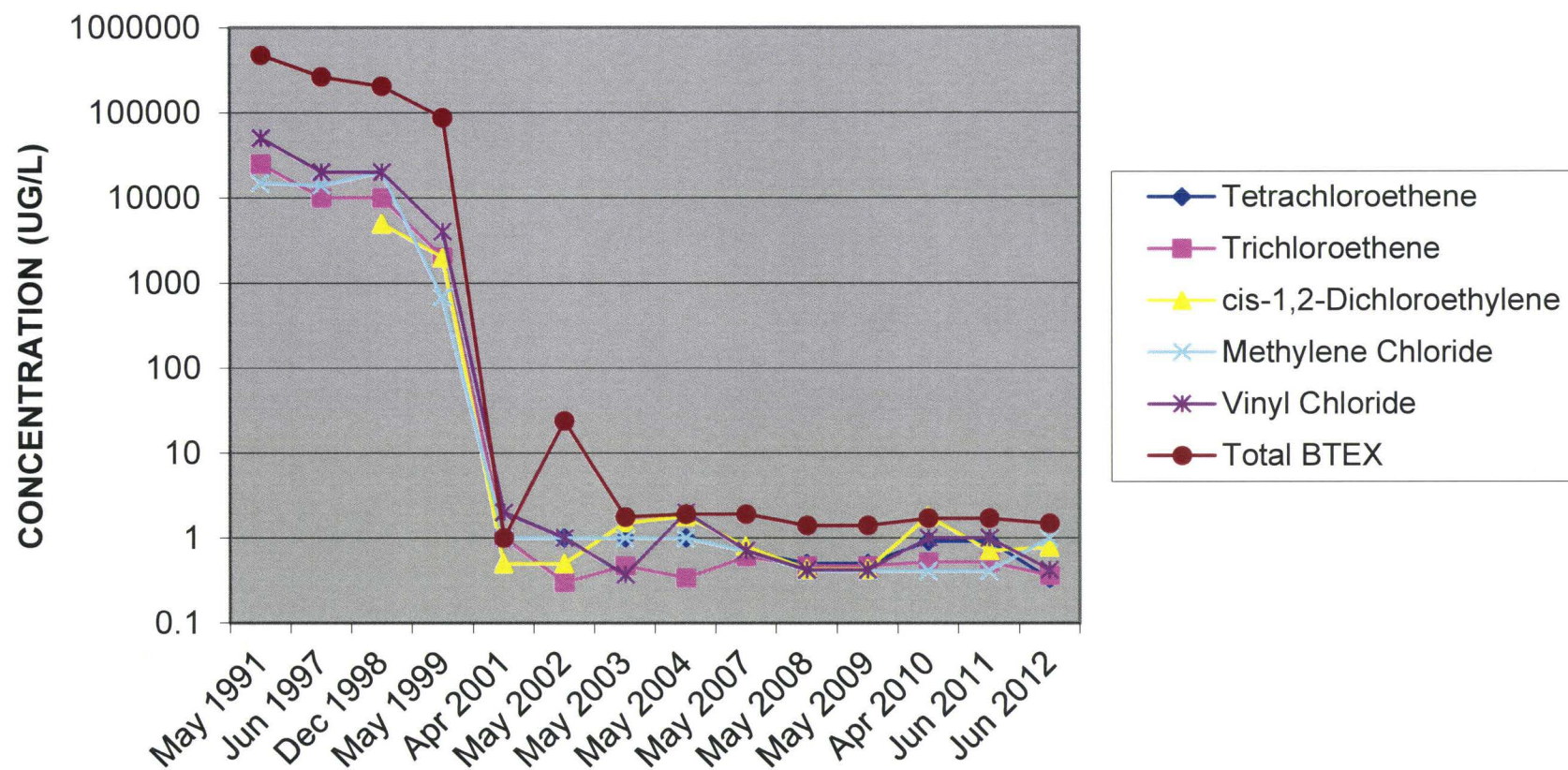
% = Percent

RL = Reporting Limit

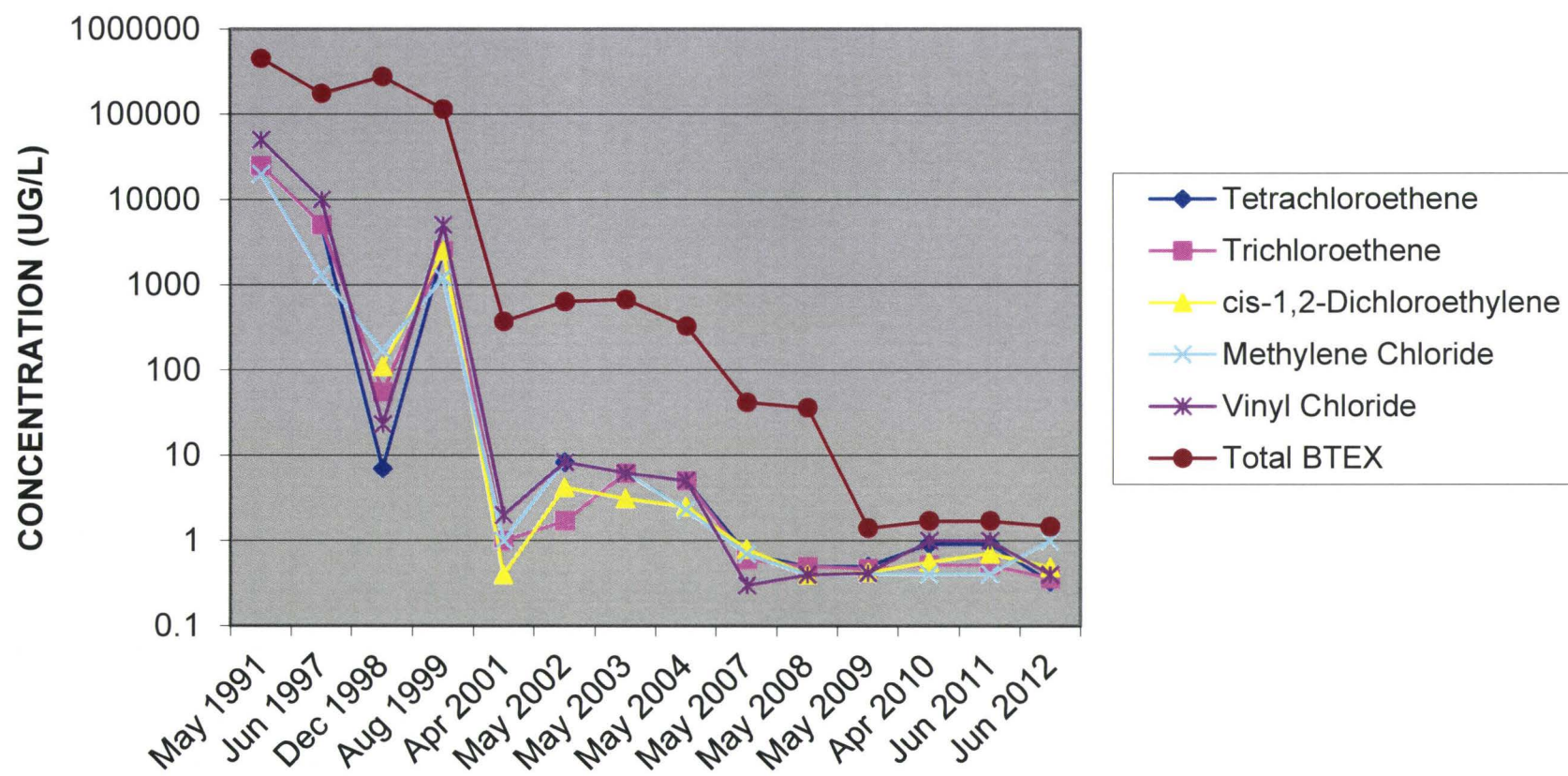
RPD = Relative Percent Difference

J = Estimated detected

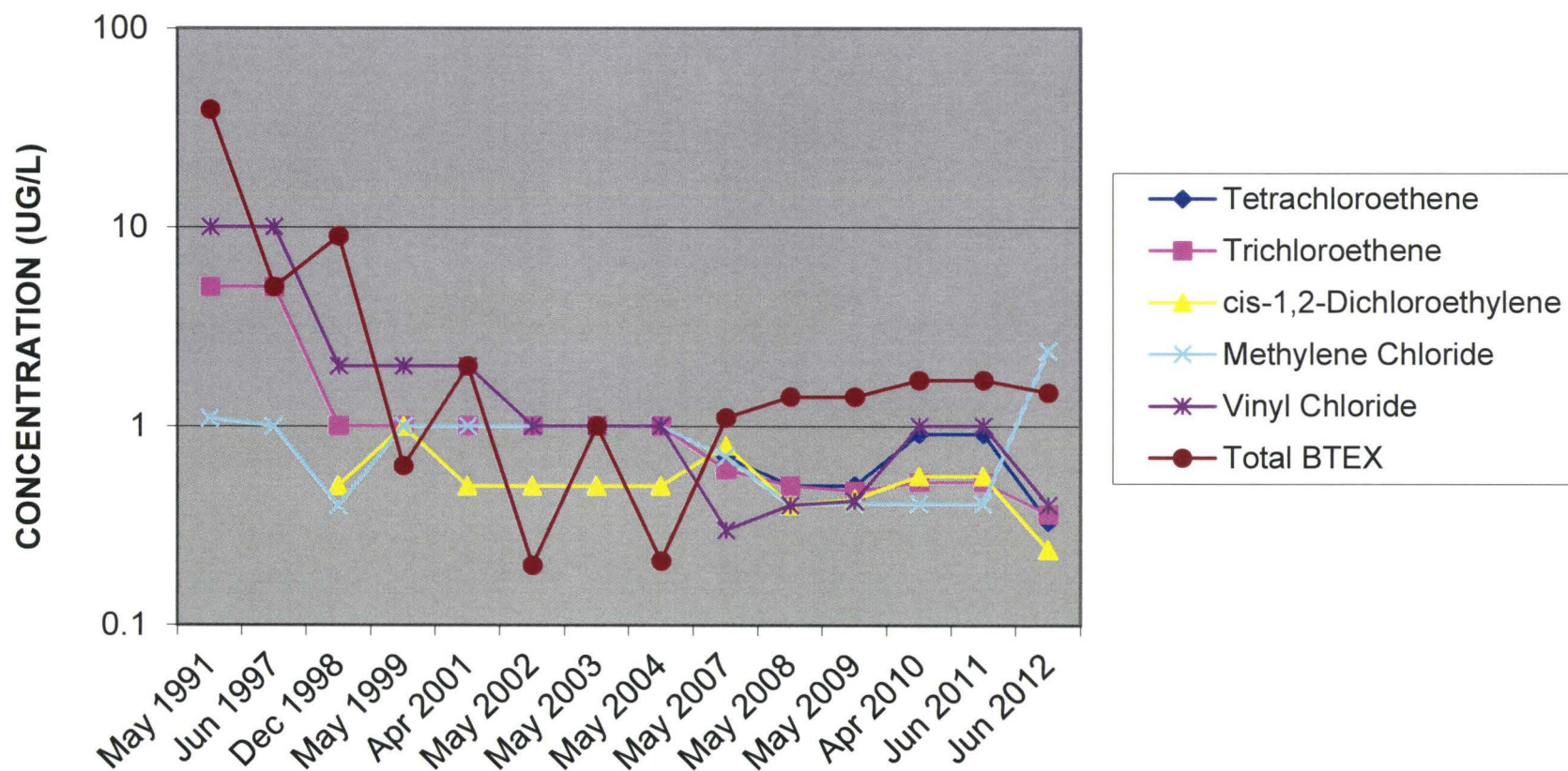
CONCENTRATIONS VS TIME IN MONITORING WELL MW-1



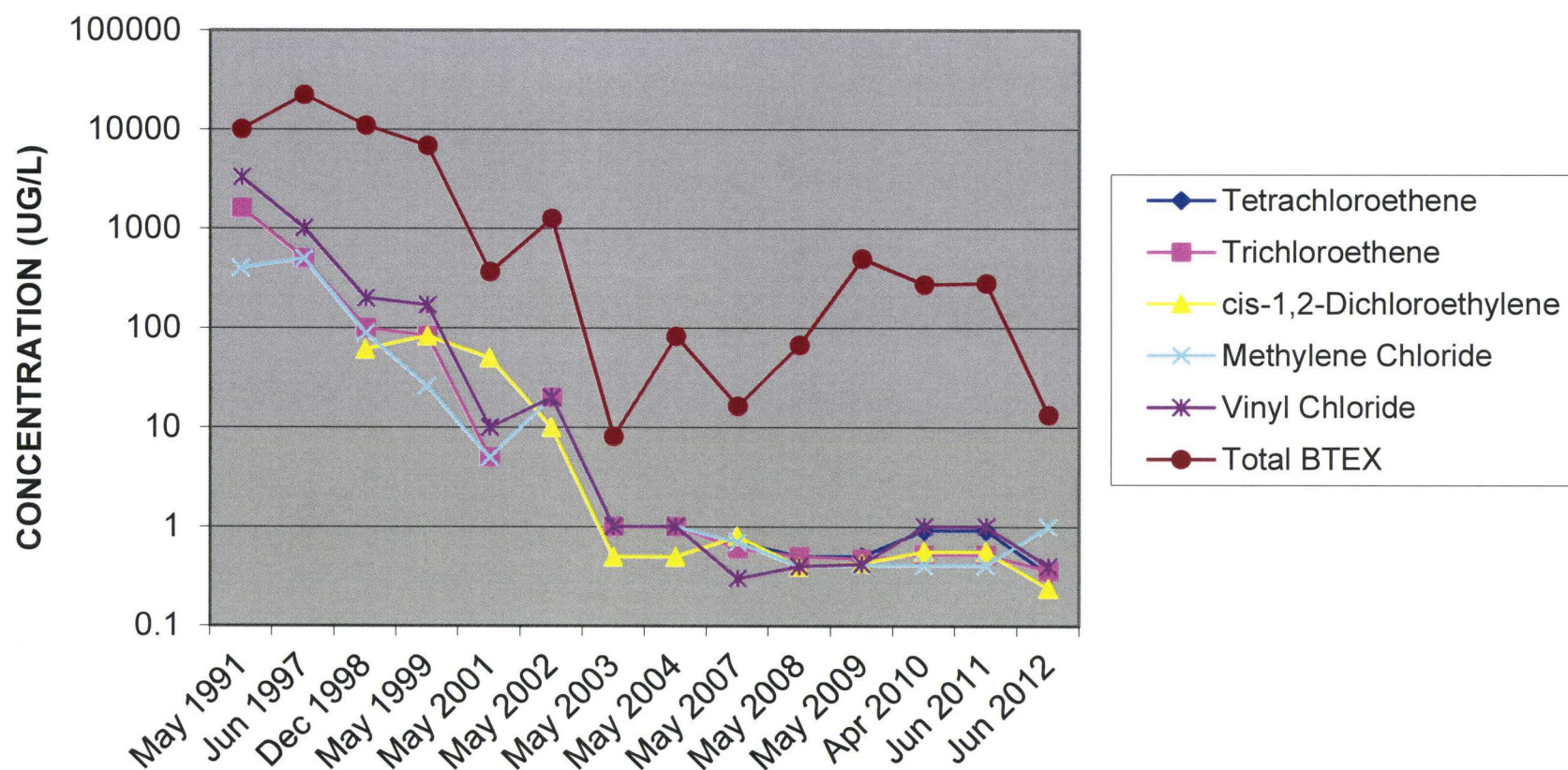
CONCENTRATIONS VS TIME IN MONITORING WELL MW-2/-2R



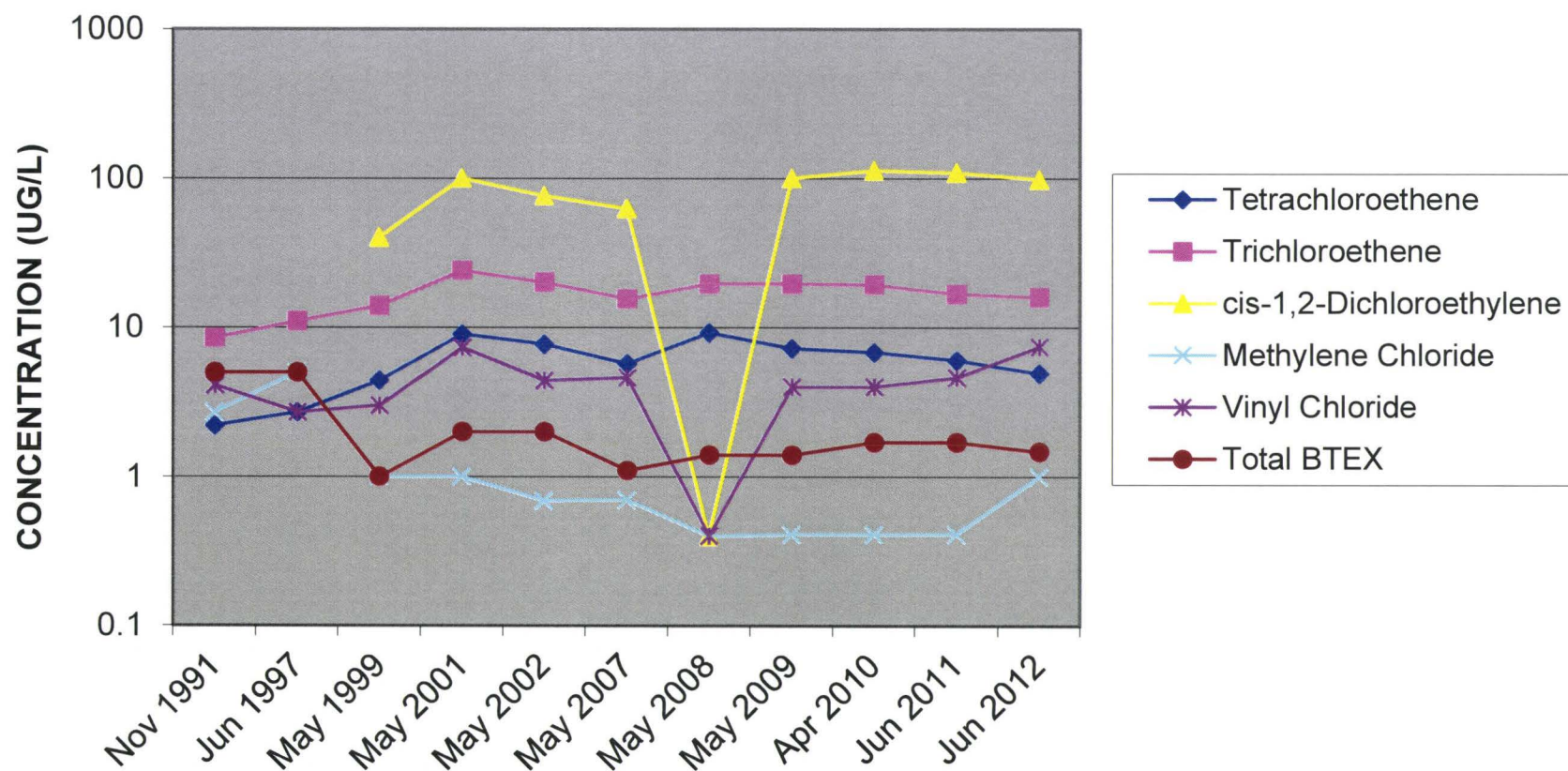
CONCENTRATIONS VS TIME IN MONITORING WELL MW-3



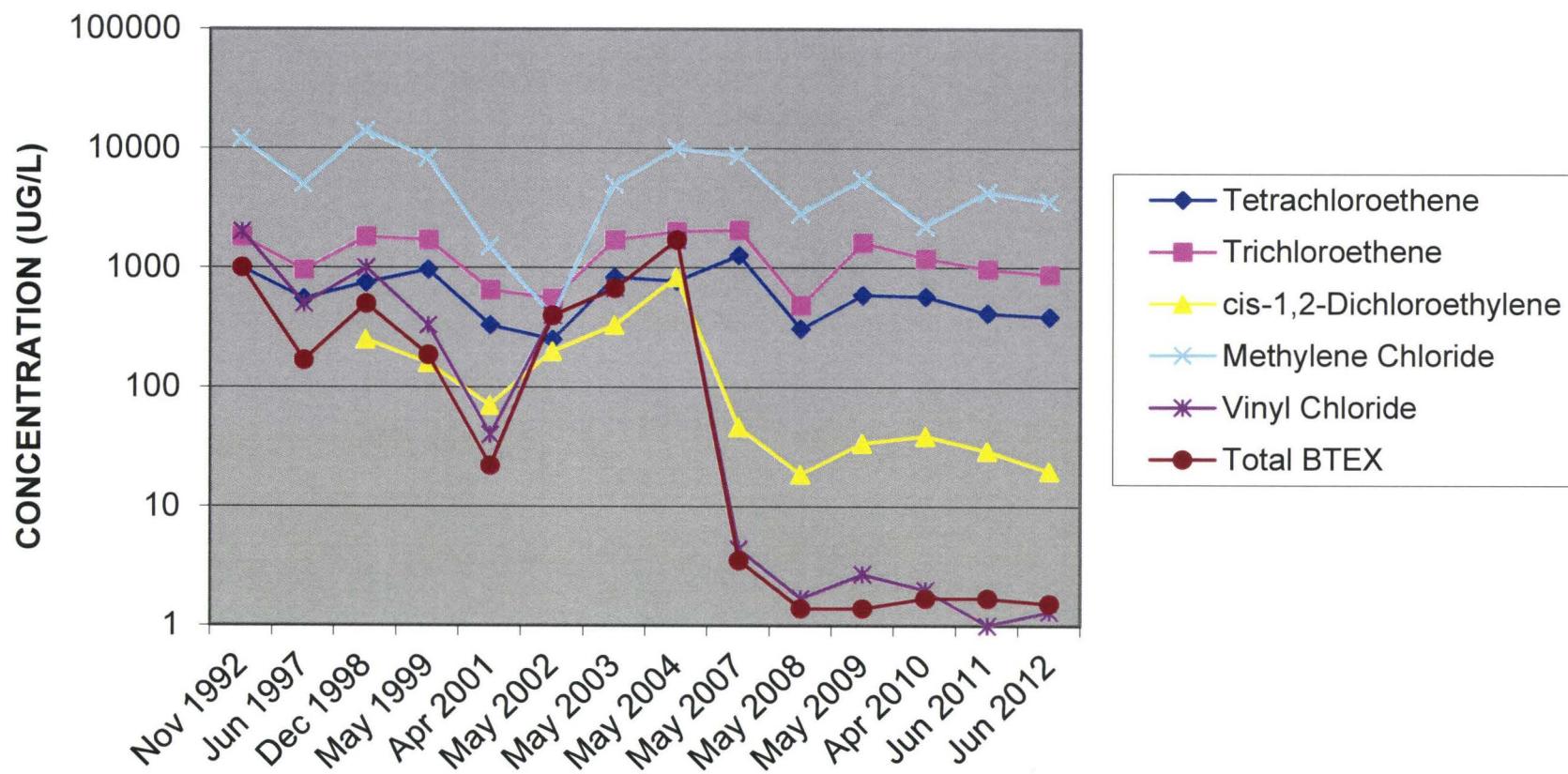
CONCENTRATIONS VS TIME IN MONITORING WELL MW-6A



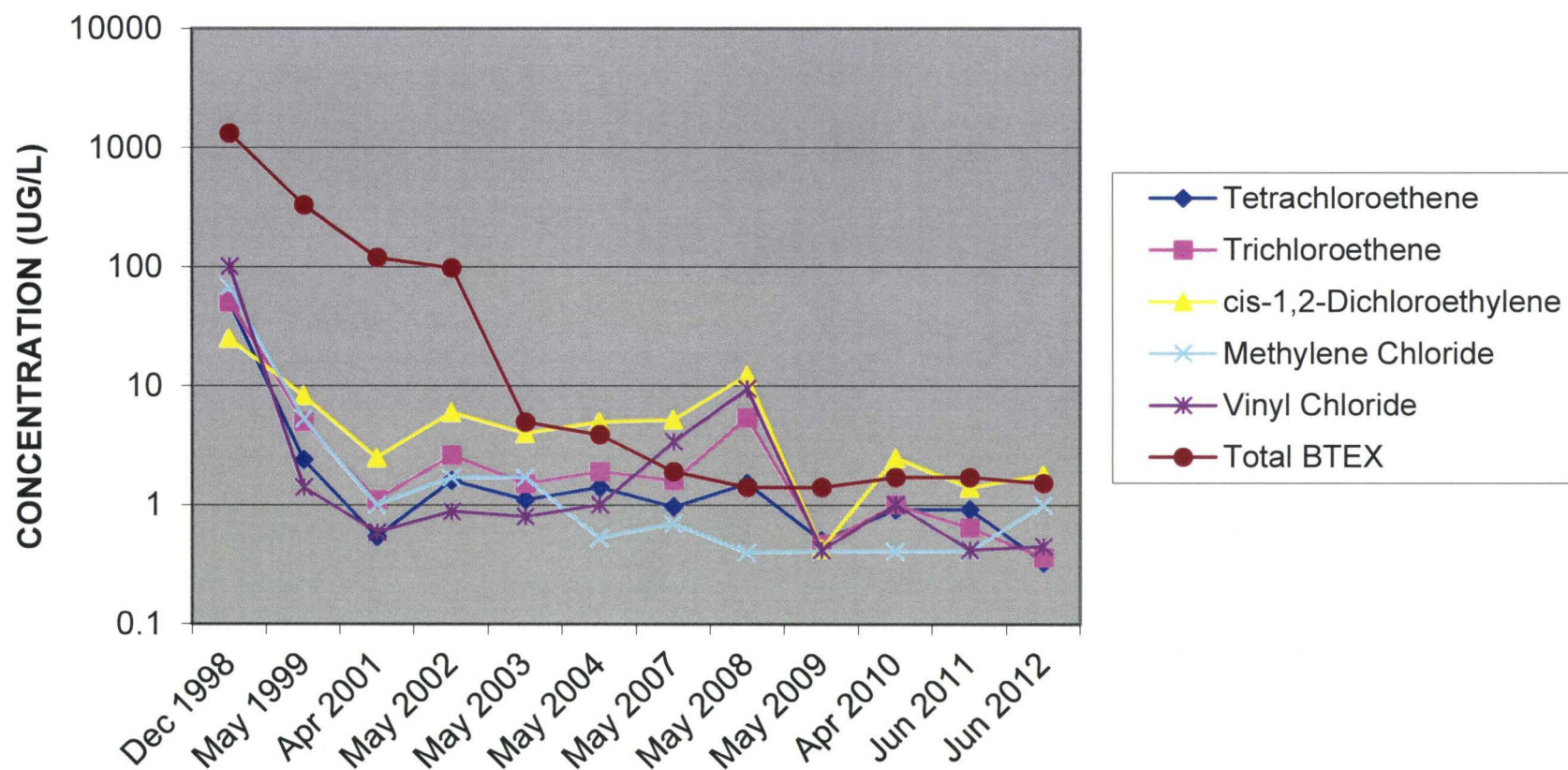
CONCENTRATIONS VS TIME IN MONITORING WELL MW-7



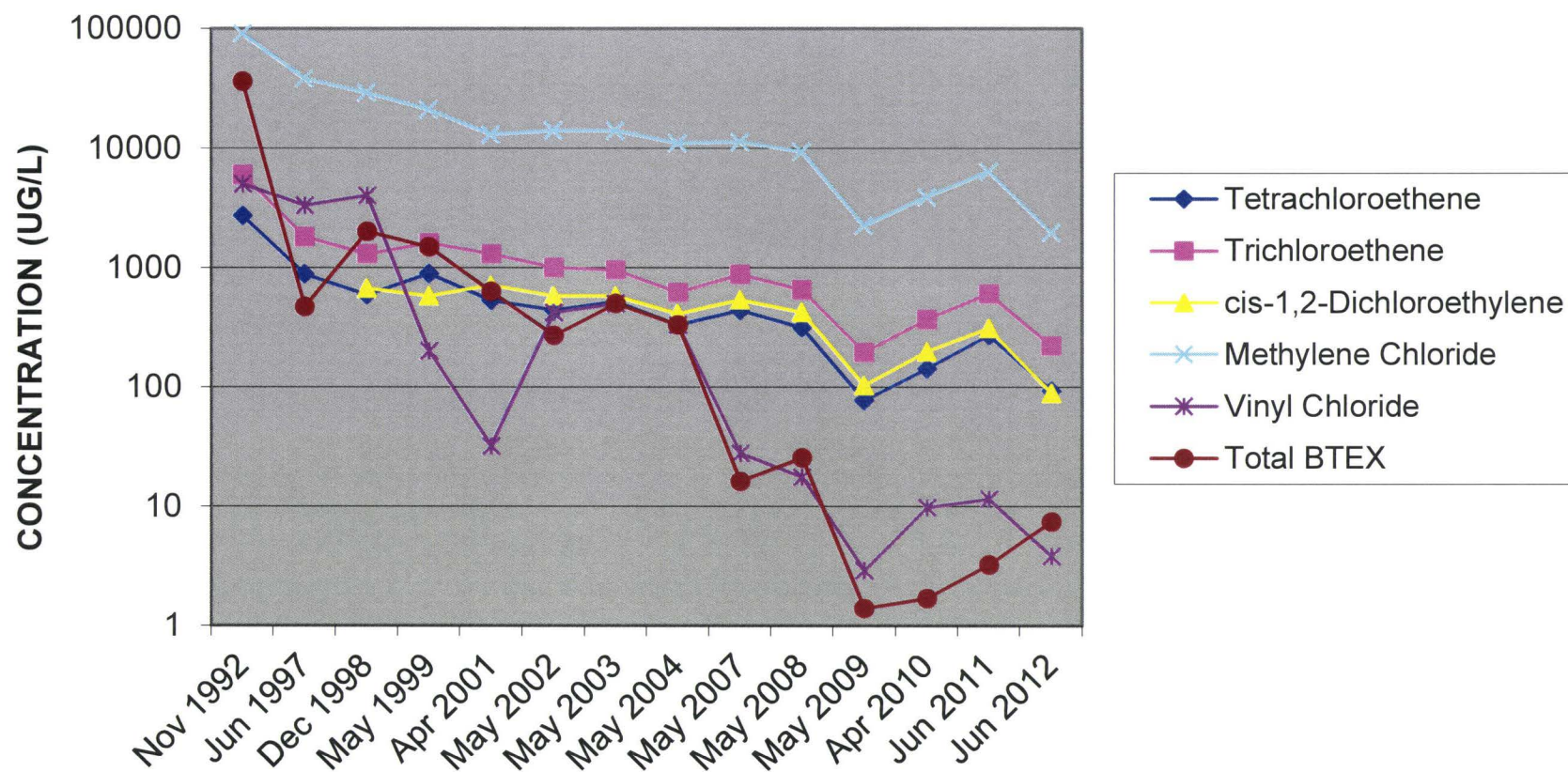
CONCENTRATIONS VS TIME IN MONITORING WELL MW-10



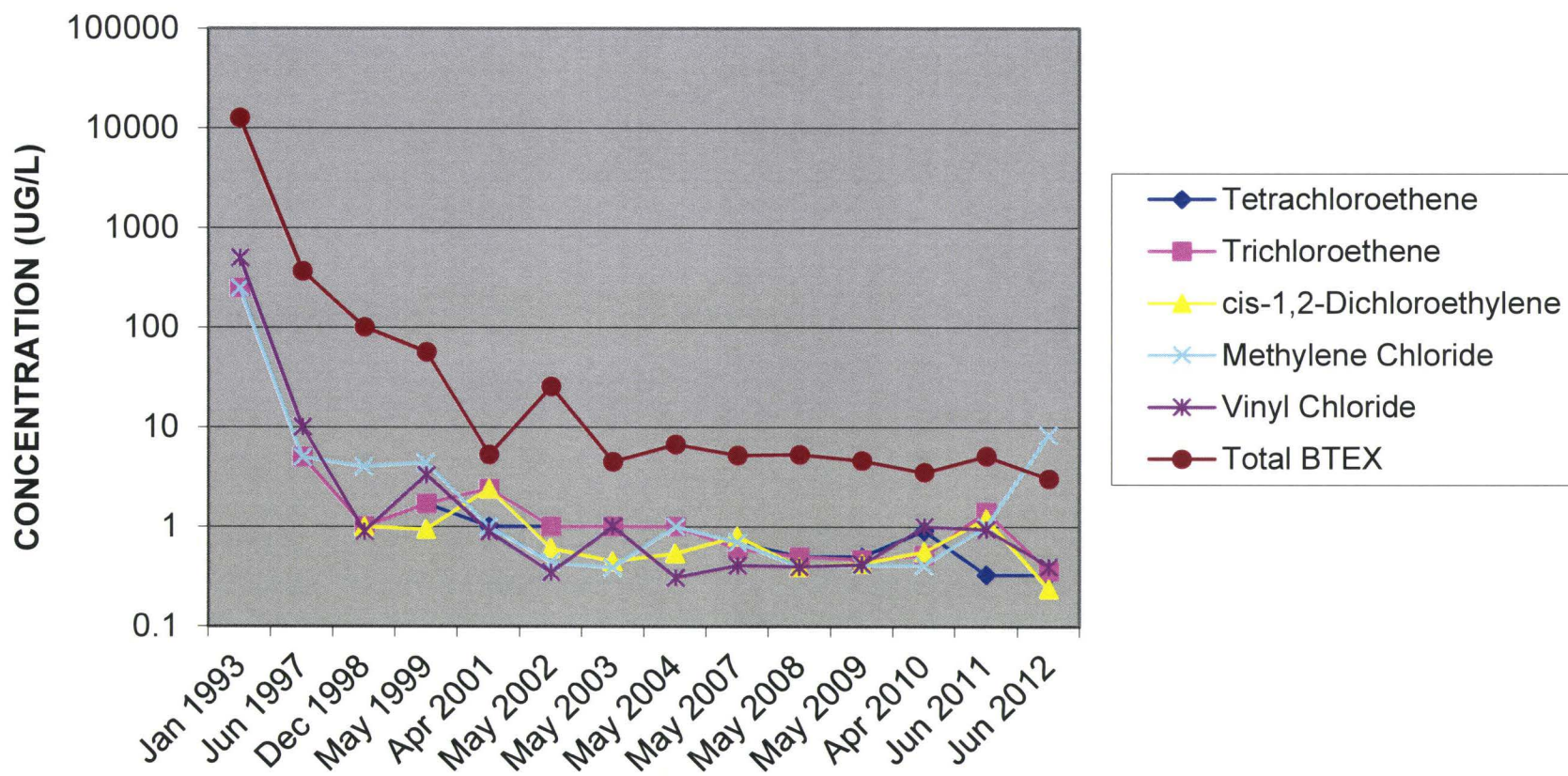
CONCENTRATIONS VS TIME IN MONITORING WELL MW-10A



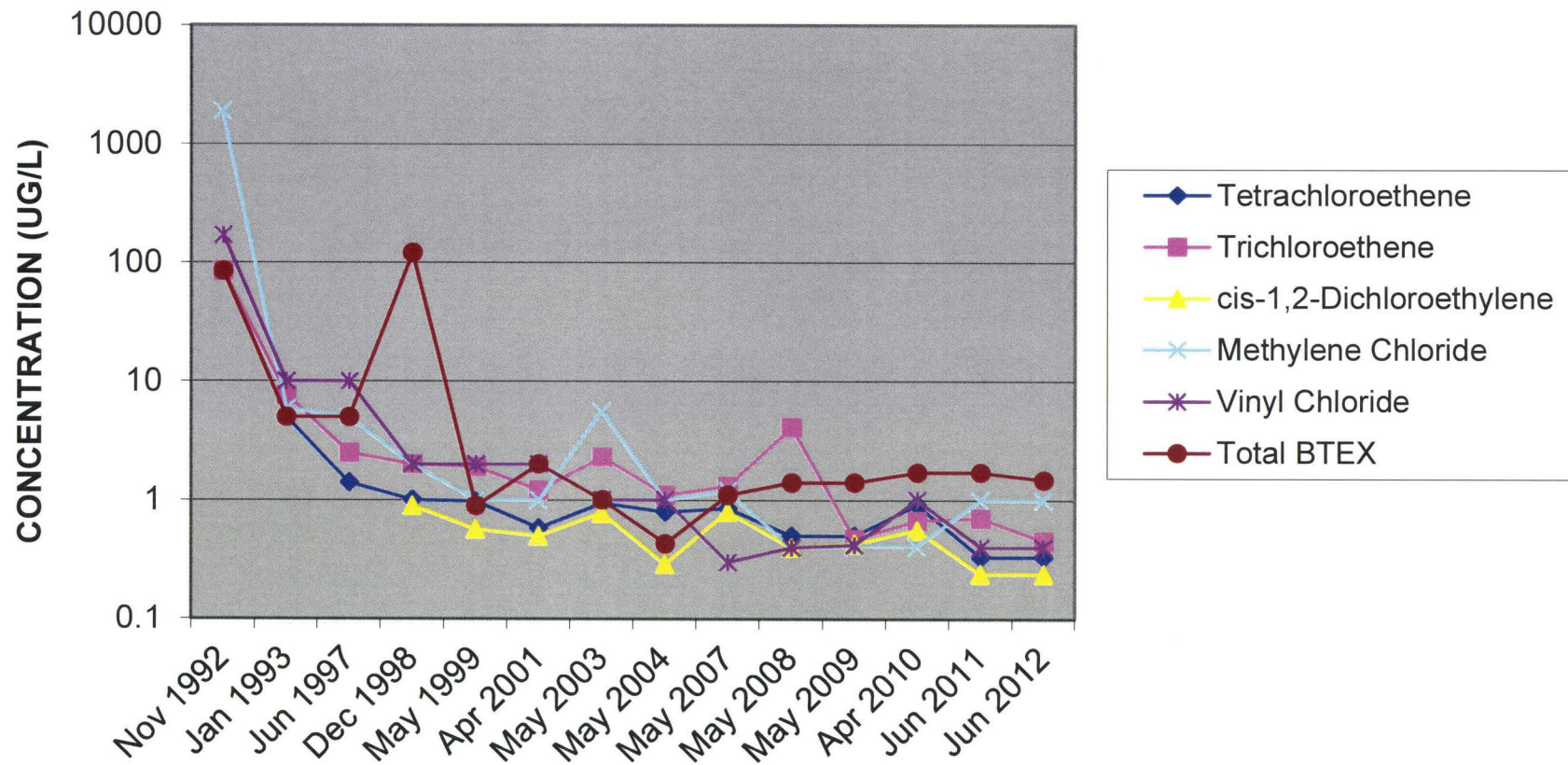
CONCENTRATIONS VS TIME IN MONITORING WELL MW-13



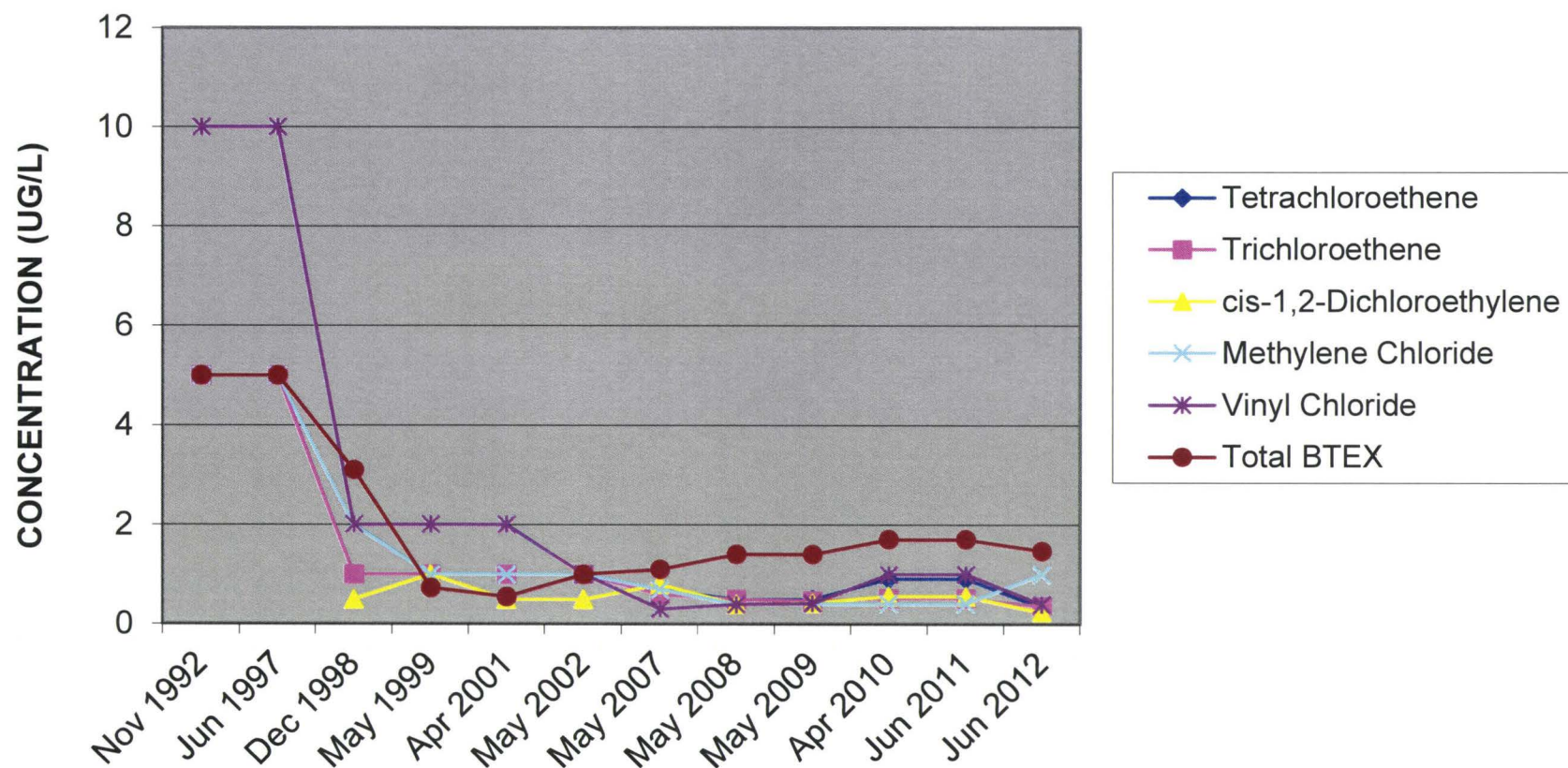
CONCENTRATIONS VS TIME IN MONITORING WELL MW-13A



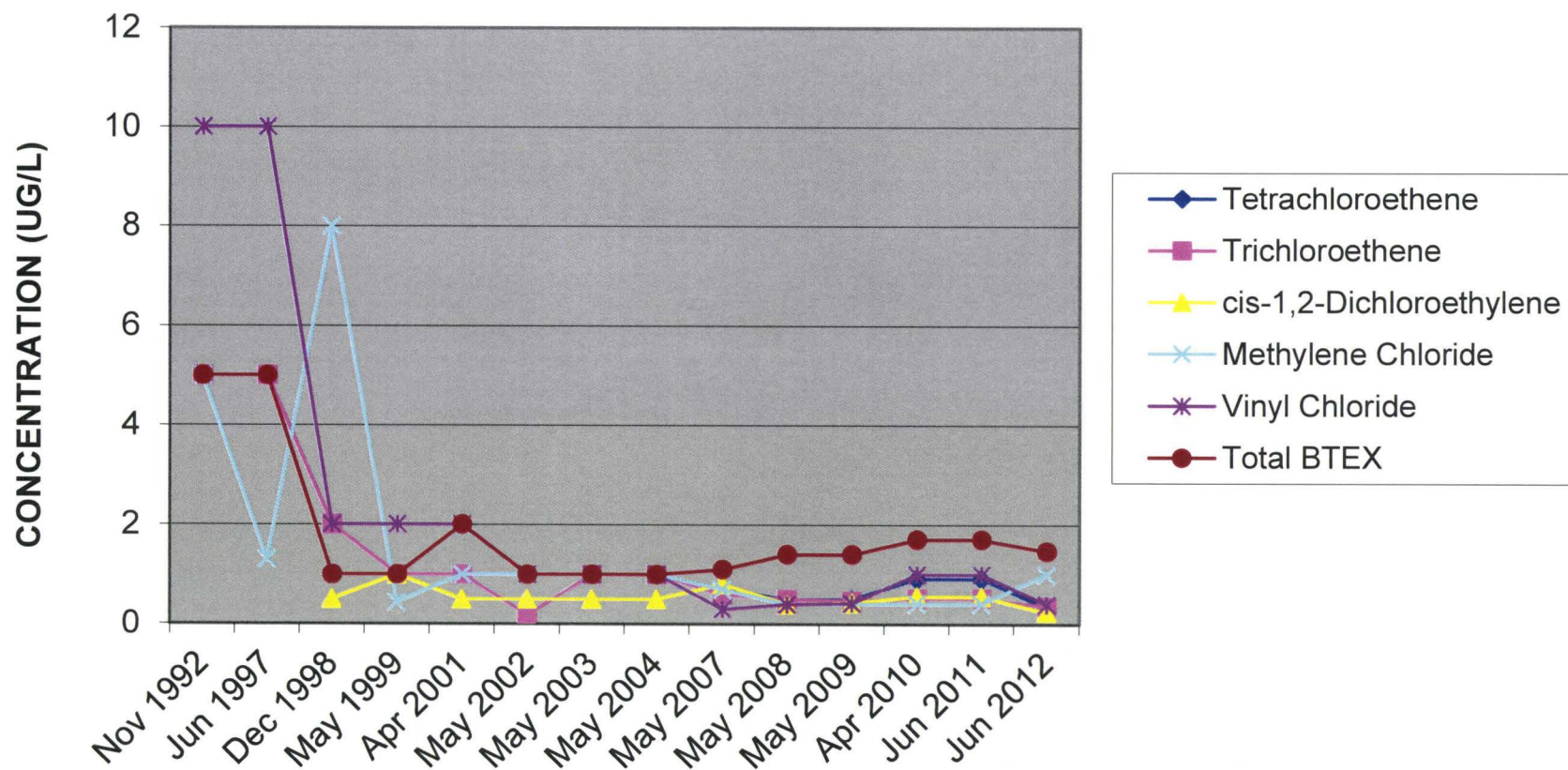
CONCENTRATIONS VS TIME IN MONITORING WELL MW-13B



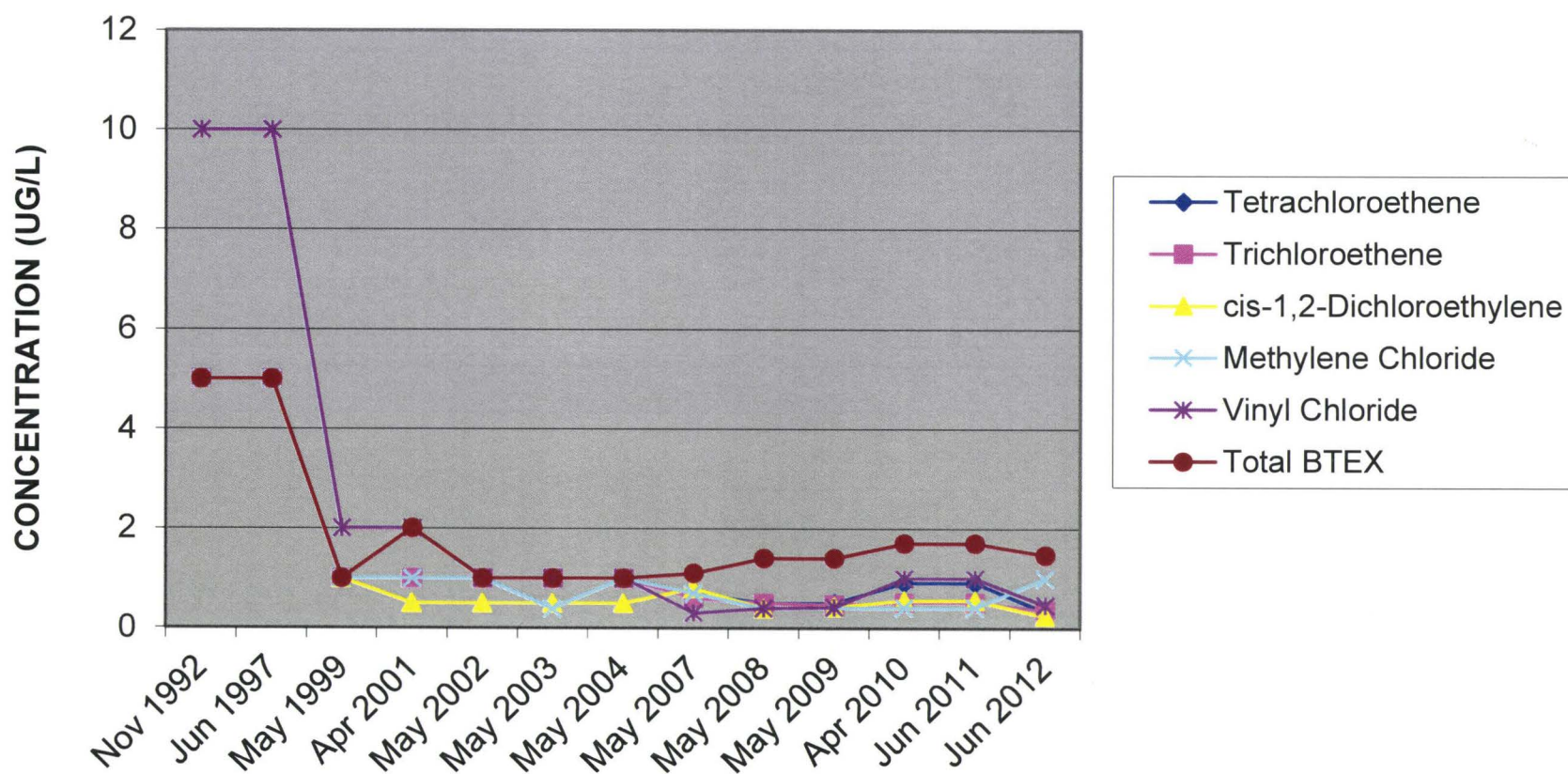
CONCENTRATIONS VS TIME IN MONITORING WELL MW-16



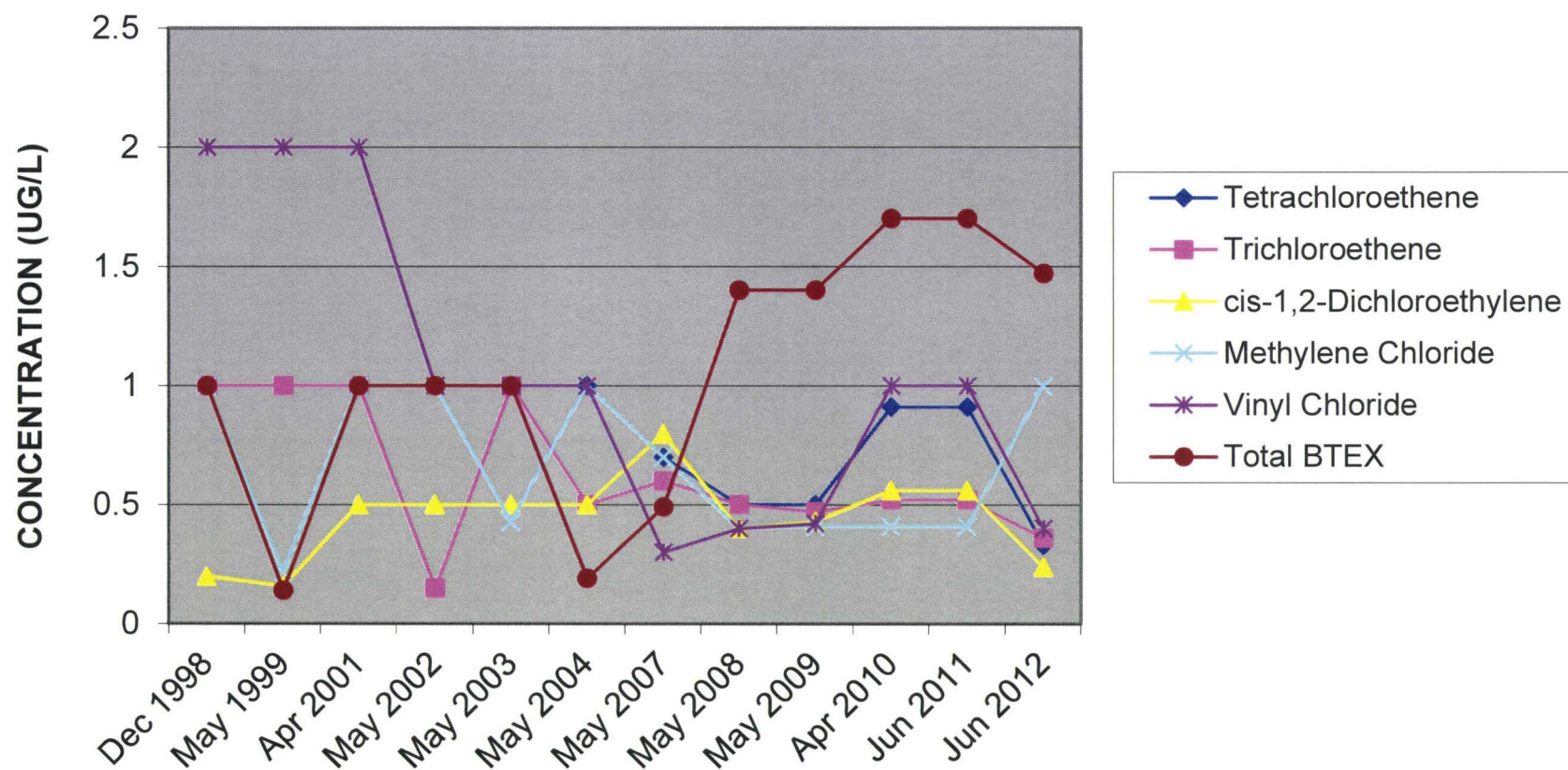
CONCENTRATIONS VS TIME IN MONITORING WELL MW-17A



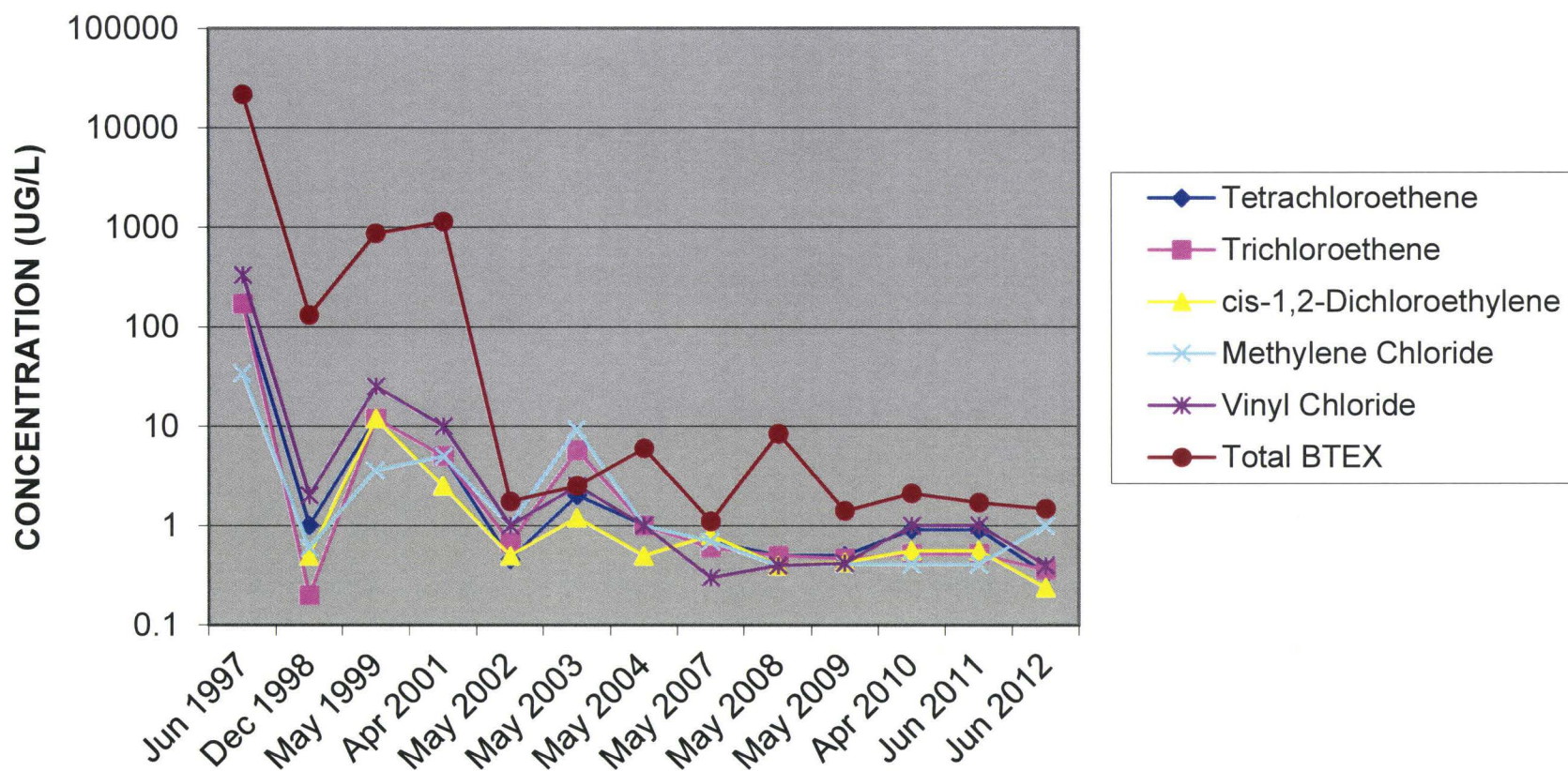
CONCENTRATIONS VS TIME IN MONITORING WELL MW-17B



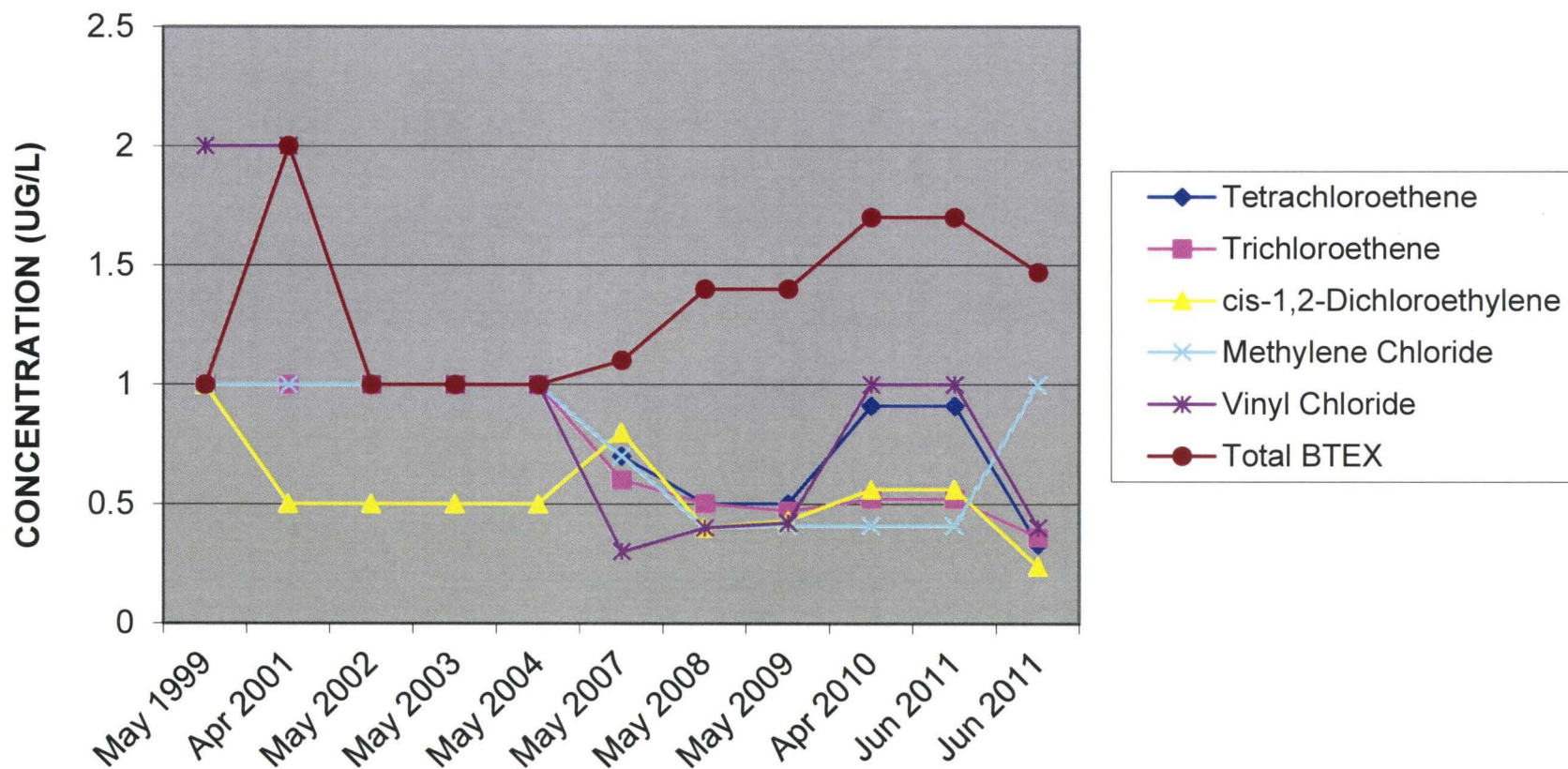
CONCENTRATIONS VS TIME IN MONITORING WELL MW-19



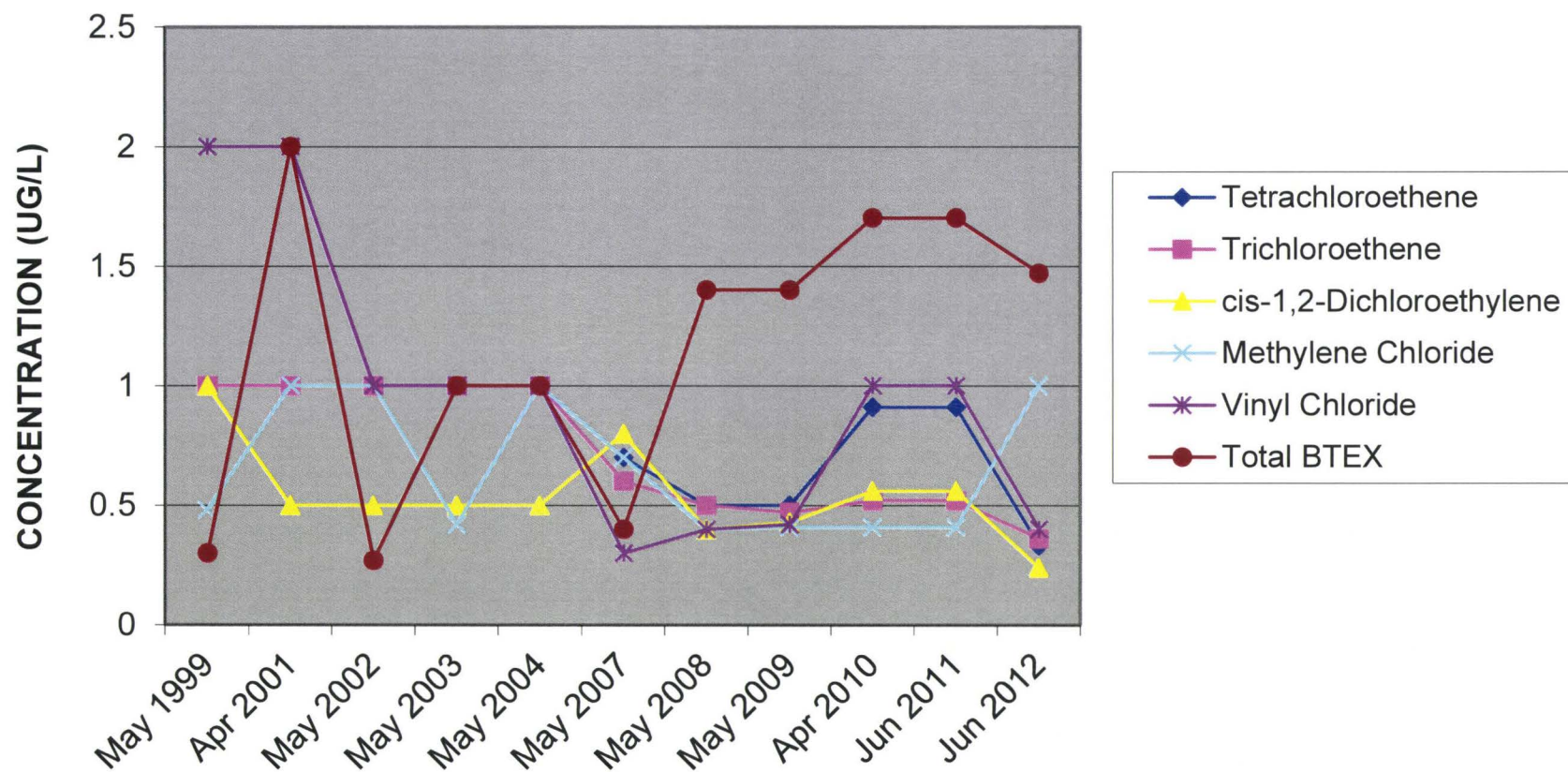
CONCENTRATIONS VS TIME IN MONITORING WELL MW-20



CONCENTRATIONS VS TIME IN MONITORING WELL MW-23A



CONCENTRATIONS VS TIME IN MONITORING WELL MW-23B



MW-1

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-1

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	1
2	May 2002	1	0.3	0.5	1	1	23.78
3	May 2003	1	0.47	1.5	1	0.37	1.76
4	May 2004	1	0.34	1.8	1	2	1.9
5	May 2007	0.7	0.6	0.8	0.7	0.71	1.9
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	1.8	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.71	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.78	1	0.42	1.47

Mann Kendall Statistic (S) =	-25.0	1.0	3.0	-16.0	-8.0	-8.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.92	0.7	0.93	4
Standard Deviation =	0.257	0.196	0.560	0.295	0.621	7.025
Coefficient of Variation(CV)=	0.327	0.387	0.608	0.402	0.666	1.848

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	No Trend	No Trend	DECREASING	No Trend	No Trend
Trend ≥ 90% Confidence Level	DECREASING	No Trend	No Trend	DECREASING	No Trend	No Trend

Stability Test, If No Trend Exists at 80% Confidence Level	NA	CV ≤ 1 STABLE	CV ≤ 1 STABLE	NA	CV ≤ 1 STABLE	CV > 1 NON-STABLE
--	----	------------------	------------------	----	------------------	----------------------

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-2/2R

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-2/2R

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.4	1	2	372
2	May 2002	8.3	1.7	4.2	8.3	8.3	636.1
3	May 2003	6.2	6.2	3.1	6.2	6.2	670
4	May 2004	5	5	2.5	2.3	5	325.9
5	May 2007	0.7	0.6	0.8	0.7	0.3	41.7
6	May 2008	0.5	0.5	0.4	0.4	0.4	35.9
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.71	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.49	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-26.0	-12.0	-19.0	-17.0	-32.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	2.4	2	1.36	2.1	2.50	209
Standard Deviation =	2.921	2.118	1.384	2.811	2.912	271.873
Coefficient of Variation(CV)=	1.200	1.255	1.018	1.330	1.164	1.302

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	DECREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	NA	NA
--	----	----	----	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-3

Mann-Kendall Statistical Test

Site Name = Facility at 3200 Main Street, Keokuk, Iowa

Well Number = MW-3

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	2
2	May 2002	1	1	0.5	1	1	0.2
3	May 2003	1	1	0.5	1	1	1
4	May 2004	1	1	0.5	1	1	0.21
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	2.4	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-30.0	-4.0	-12.0	-14.0	19.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.9	0.85	1
Standard Deviation =	0.257	0.267	0.141	0.605	0.509	0.607
Coefficient of Variation(CV)=	0.327	0.384	0.283	0.693	0.597	0.499

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	No Trend	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV ≤ 1 STABLE	NA	NA	NA
--	----	----	------------------	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-6A

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-6A

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	May 2001	5	5	50	5	10	365.7
2	May 2002	20	20	10	20	20	1250
3	May 2003	1	1	0.5	1	1	8.05
4	May 2004	1	1	0.5	1	1	81.9
5	May 2007	0.7	0.6	0.8	0.7	0.3	16.3
6	May 2008	0.5	0.5	0.4	0.4	0.4	66.9
7	May 2009	0.5	0.47	0.43	0.41	0.42	491
8	Apr 2010	0.91	0.52	0.56	0.41	1	272
9	Jun 2011	0.91	0.52	0.56	0.41	1	280
10	Jun 2012	0.33	0.36	0.24	1	0.4	13.2

Mann Kendall Statistic (S) =	-28.0	-33.0	-21.0	-21.0	-16.0	-5.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	3.1	3	6.40	3.0	3.55	285
Standard Deviation =	6.097	6.134	15.609	6.121	6.484	378.881
Coefficient of Variation(CV)=	1.976	2.047	2.439	2.018	1.826	1.332

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	No Trend
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	No Trend

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	NA	CV > 1 NON-STABLE
--	----	----	----	----	----	----------------------

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-7

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-7

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Jun 1997	2.7	11		5	2.7	5
2	May 1999	4.4	14	40	1	3	1
3	May 2001	9.0	24	100	1	7.3	2
4	May 2002	7.7	20	76	0.69	4.4	2
5	May 2007	5.7	15.5	62.2	0.7	4.6	1.1
6	May 2008	9.2	19.6	0.4	0.4	0.4	1.4
7	May 2009	7.2	19.6	100	0.41	4	1.4
8	Apr 2010	6.8	19.3	113	0.41	4	1.7
9	Jun 2011	6	16.7	109	0.41	4.6	1.7
10	Jun 2012	4.9	15.9	98.5	1	7.4	1.47

Mann Kendall Statistic (S) =	1.0	0.0	11.0	-19.0	15.0	-4.0
Number of Rounds (n) =	10	10	9	10	10	10
Average =	6.4	18	77.68	1.1	4.24	2
Standard Deviation =	2.046	3.685	37.571	1.394	2.066	1.147
Coefficient of Variation(CV)=	0.322	0.210	0.484	1.265	0.487	0.611

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	No Trend	No Trend	INCREASING	DECREASING	INCREASING	No Trend
Trend ≥ 90% Confidence Level	No Trend	No Trend	No Trend	DECREASING	No Trend	No Trend

Stability Test, If No Trend Exists at 80% Confidence Level	CV <= 1 STABLE	CV <= 1 STABLE	NA	NA	NA	CV <= 1 STABLE
--	-------------------	-------------------	----	----	----	-------------------

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-10**Mann-Kendall Statistical Test**

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = **MW-10**

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	330	650	71	1500	40	22
2	May 2002	250	550	200	400	400	400
3	May 2003	830	1700	330	5000	670	670
4	May 2004	770	2000	830	10000	1700	1700
5	May 2007	1260	2040	46.5	8680	4.4	3.54
6	May 2008	308	485	18.7	2820	1.7	1.4
7	May 2009	588	1610	34.1	5480	2.7	1.4
8	Apr 2010	571	1190	39.2	2230	2	1.7
9	Jun 2011	413	966	29.3	4250	1	1.7
10	Jun 2012	387	868	19.8	3550	1.3	0.31

Mann Kendall Statistic (S) =	-3.0	-3.0	-23.0	3.0	-27.0	-23.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	570.7	1206	161.86	4391.0	282.31	280
Standard Deviation =	311.056	592.983	255.455	3047.117	548.082	549.167
Coefficient of Variation(CV)=	0.545	0.492	1.578	0.694	1.941	1.960

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	No Trend	No Trend	DECREASING	No Trend	DECREASING	DECREASING
Trend ≥ 90% Confidence Level	No Trend	No Trend	DECREASING	No Trend	DECREASING	DECREASING

Stability Test, If No Trend Exists at 80% Confidence Level	CV <= 1 STABLE	CV <= 1 STABLE	NA	CV <= 1 STABLE	NA	NA
--	-------------------	-------------------	----	-------------------	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-10A

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-10A

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	0.54	1.1	2.5	1	0.59	118.6
2	May 2002	1.6	2.6	6	1.7	0.88	96.9
3	May 2003	1.1	1.5	4	1.7	0.8	4.95
4	May 2004	1.4	1.9	5	0.53	1	3.87
5	May 2007	0.96	1.6	5.2	0.7	3.4	1.9
6	May 2008	1.5	5.4	12.3	0.4	9.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	1	2.5	0.41	1	1.7
9	Jun 2011	0.91	0.64	1.4	0.41	1	1.7
10	Jun 2012	0.33	0.36	1.8	1	0.45	0.29

Mann Kendall Statistic (S) =	-18.0	-19.0	-12.0	-16.0	4.0	-35.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	1.0	2	4.11	0.8	1.89	23
Standard Deviation =	0.435	1.485	3.400	0.516	2.773	44.837
Coefficient of Variation(CV)=	0.446	0.896	0.827	0.624	1.464	1.927

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	No Trend	DECREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	No Trend	DECREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	CV > 1 NON-STABLE	NA
--	----	----	----	----	----------------------	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-13

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-13

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	530	1300	710	13000	32	630
2	May 2002	440	1000	580	14000	420	270
3	May 2003	520	950	580	14000	500	500
4	May 2004	330	620	410	11000	330	330
5	May 2007	437	876	537	11300	27.7	16.1
6	May 2008	312	649	423	9320	17.5	25.5
7	May 2009	76.8	194	103	2240	2.9	1.4
8	Apr 2010	171	370	197	3900	9.7	1.7
9	Jun 2011	270	602	310	6390	11.4	3.24
10	Jun 2012	92.5	220	88.9	1960	3.8	1.47

Mann Kendall Statistic (S) =	-33.0	-33.0	-34.0	-32.0	-29.0	-31.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	317.9	678	393.89	8711.0	135.50	178
Standard Deviation =	165.970	357.867	214.535	4745.038	198.338	238.746
Coefficient of Variation(CV)=	0.522	0.528	0.545	0.545	1.464	1.342

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	NA	NA
--	----	----	----	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-13A

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-13A

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	2.4	2.4	1	0.89	5.3
2	May 2002	1	1	0.61	0.44	0.35	25.5
3	May 2003	1	1	0.45	0.39	1	4.5
4	May 2004	1	1	0.54	1	0.31	6.71
5	May 2007	0.7	0.6	0.8	0.7	0.41	5.2
6	May 2008	0.5	0.5	0.4	0.4	0.4	5.3
7	May 2009	0.5	0.47	0.43	0.41	0.42	4.6
8	Apr 2010	0.91	0.52	0.56	0.41	1	3.5
9	Jun 2011	0.33	1.4	1.2	1	0.94	5.1
10	Jun 2012	0.33	0.36	0.24	8.3	0.4	2.06

Mann Kendall Statistic (S) =	-31.0	-24.0	-13.0	7.0	5.0	-24.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.7	1	0.76	1.4	0.61	7
Standard Deviation =	0.289	0.614	0.633	2.438	0.301	6.693
Coefficient of Variation(CV)=	0.397	0.664	0.829	1.735	0.491	0.988

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	No Trend	No Trend	DECREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	No Trend	No Trend	DECREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	CV > 1 NON-STABLE	CV ≤ 1 STABLE	NA
--	----	----	----	----------------------	------------------	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-13B

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-13B

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	May 1999	0.97	1.9	0.57	1	2	0.89
2	Apr 2001	0.58	1.2	0.5	1	2	2
3	May 2003	0.94	2.3	0.78	5.6	1	1
4	May 2004	0.79	1.1	0.29	1	1	0.43
5	May 2007	0.85	1.3	0.8	1.2	0.3	1.1
6	May 2008	0.5	4.1	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.67	0.56	0.41	1	1.7
9	Jun 2011	0.33	0.7	0.24	1	0.4	1.7
10	Jun 2012	0.33	0.45	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-21.0	-18.0	-8.0	-22.0	19.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.7	1	0.48	1.3	0.89	1
Standard Deviation =	0.250	1.119	0.202	1.540	0.649	0.461
Coefficient of Variation(CV)=	0.374	0.789	0.420	1.183	0.727	0.352

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	No Trend	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	DECREASING	No Trend	DECREASING	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	CV > 1 NON-STABLE	NA	NA
--	----	----	----	----------------------	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-16

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-16

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Dec 1998	1	1	0.5	2	2	3.1
2	May 1999	1	1	1	1	2	0.73
3	Apr 2001	1.0	1	0.5	1	2	0.55
4	May 2002	1	1	0.5	1	1	1
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-30.0	-11.0	-20.0	-18.0	19.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.55	0.8	1.05	1
Standard Deviation =	0.257	0.267	0.212	0.496	0.709	0.707
Coefficient of Variation(CV)=	0.327	0.384	0.387	0.596	0.674	0.499

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	NA	NA
--	----	----	----	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-17A

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-17A

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1.0	1	0.5	1	2	2
2	May 2002	1	0.19	0.5	1	1	1
3	May 2003	1	1	0.5	1	1	1
4	May 2004	1	1	0.5	1	1	1
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-17.0	-4.0	-16.0	-14.0	18.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.7	0.85	1
Standard Deviation =	0.257	0.287	0.141	0.295	0.509	0.351
Coefficient of Variation(CV)=	0.327	0.466	0.283	0.402	0.597	0.255

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV <= 1 STABLE	NA	NA	NA
--	----	----	-------------------	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-17B

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-17B

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	2
2	May 2002	1.0	1	0.5	1	1	1
3	May 2003	1	1	0.5	0.39	1	1
4	May 2004	1	1	0.5	1	1	1
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.46	1.47

Mann Kendall Statistic (S) =	-25.0	-30.0	-4.0	-6.0	-11.0	18.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.7	0.86	1
Standard Deviation =	0.257	0.267	0.141	0.296	0.503	0.351
Coefficient of Variation(CV)=	0.327	0.384	0.283	0.441	0.586	0.255

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	No Trend	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	No Trend	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV ≤ 1 STABLE	CV ≤ 1 STABLE	NA	NA
--	----	----	------------------	------------------	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-19

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-19

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	1
2	May 2002	1	0.15	0.5	1	1	1
3	May 2003	1.0	1	0.5	0.43	1	1
4	May 2004	1	0.5	0.5	1	1	0.19
5	May 2007	0.7	0.6	0.8	0.7	0.3	0.49
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-12.0	-4.0	-14.0	-14.0	24.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.7	0.85	1
Standard Deviation =	0.257	0.261	0.141	0.292	0.509	0.501
Coefficient of Variation(CV)=	0.327	0.465	0.283	0.433	0.597	0.441

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	No Trend	No Trend	No Trend	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV ≤ 1 STABLE	NA	NA	NA
--	----	----	------------------	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-20

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-20

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	5	5	2.5	5	10	1130
2	May 2002	0.5	0.68	0.5	1	1	1.75
3	May 2003	2	5.7	1.2	9.4	2.5	2.5
4	May 2004	1	1	0.5	1	1	5.97
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	8.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	2.1
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-17.0	-30.0	-19.0	-19.0	-16.0	-15.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	1.2	2	0.77	2.0	1.80	116
Standard Deviation =	1.407	2.025	0.662	2.955	2.951	356.418
Coefficient of Variation(CV)=	1.143	1.319	0.861	1.498	1.638	3.082

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	DECREASING	DECREASING	DECREASING	No Trend

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	NA	NA	NA	NA
--	----	----	----	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-23A

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-23A

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	2
2	May 2002	1	1	0.5	1	1	1
3	May 2003	1.0	1	0.5	1	1	1
4	May 2004	1	1	0.5	1	1	1
5	May 2007	0.7	0.6	0.8	0.7	0.3	1.1
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-30.0	-4.0	-16.0	-14.0	18.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.7	0.85	1
Standard Deviation =	0.257	0.267	0.141	0.295	0.509	0.351
Coefficient of Variation(CV)=	0.327	0.384	0.283	0.402	0.597	0.255

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV ≤ 1 STABLE	NA	NA	NA
--	----	----	------------------	----	----	----

Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

MW-23B

Mann-Kendall Statistical Test

Site Name = Facility at 3200 MainStreet, Keokuk, Iowa

Well Number = MW-23B

Event Number	Sampling Date	Tetrachloroethene UG/L	Trichloroethene UG/L	cis-1,2-Dichloroethylene UG/L	Methylene Chloride UG/L	Vinyl Chloride UG/L	Total BTEX UG/L
1	Apr 2001	1	1	0.5	1	2	2
2	May 2002	1	1	0.5	1	1	0.27
3	May 2003	1.0	1	0.5	0.42	1	1
4	May 2004	1	1	0.5	1	1	1
5	May 2007	0.7	0.6	0.8	0.7	0.3	0.4
6	May 2008	0.5	0.5	0.4	0.4	0.4	1.4
7	May 2009	0.5	0.47	0.43	0.41	0.42	1.4
8	Apr 2010	0.91	0.52	0.56	0.41	1	1.7
9	Jun 2011	0.91	0.52	0.56	0.41	1	1.7
10	Jun 2012	0.33	0.36	0.24	1	0.4	1.47

Mann Kendall Statistic (S) =	-25.0	-30.0	-4.0	-14.0	-14.0	16.0
Number of Rounds (n) =	10	10	10	10	10	10
Average =	0.8	1	0.50	0.7	0.85	1
Standard Deviation =	0.257	0.267	0.141	0.293	0.509	0.564
Coefficient of Variation(CV)=	0.327	0.384	0.283	0.435	0.597	0.457

Error Check, Blank if No Errors Detected

Trend ≥ 80% Confidence Level	DECREASING	DECREASING	No Trend	DECREASING	DECREASING	INCREASING
Trend ≥ 90% Confidence Level	DECREASING	DECREASING	No Trend	No Trend	No Trend	INCREASING

Stability Test, If No Trend Exists at 80% Confidence Level	NA	NA	CV ≤ 1 STABLE	NA	NA	NA
--	----	----	------------------	----	----	----

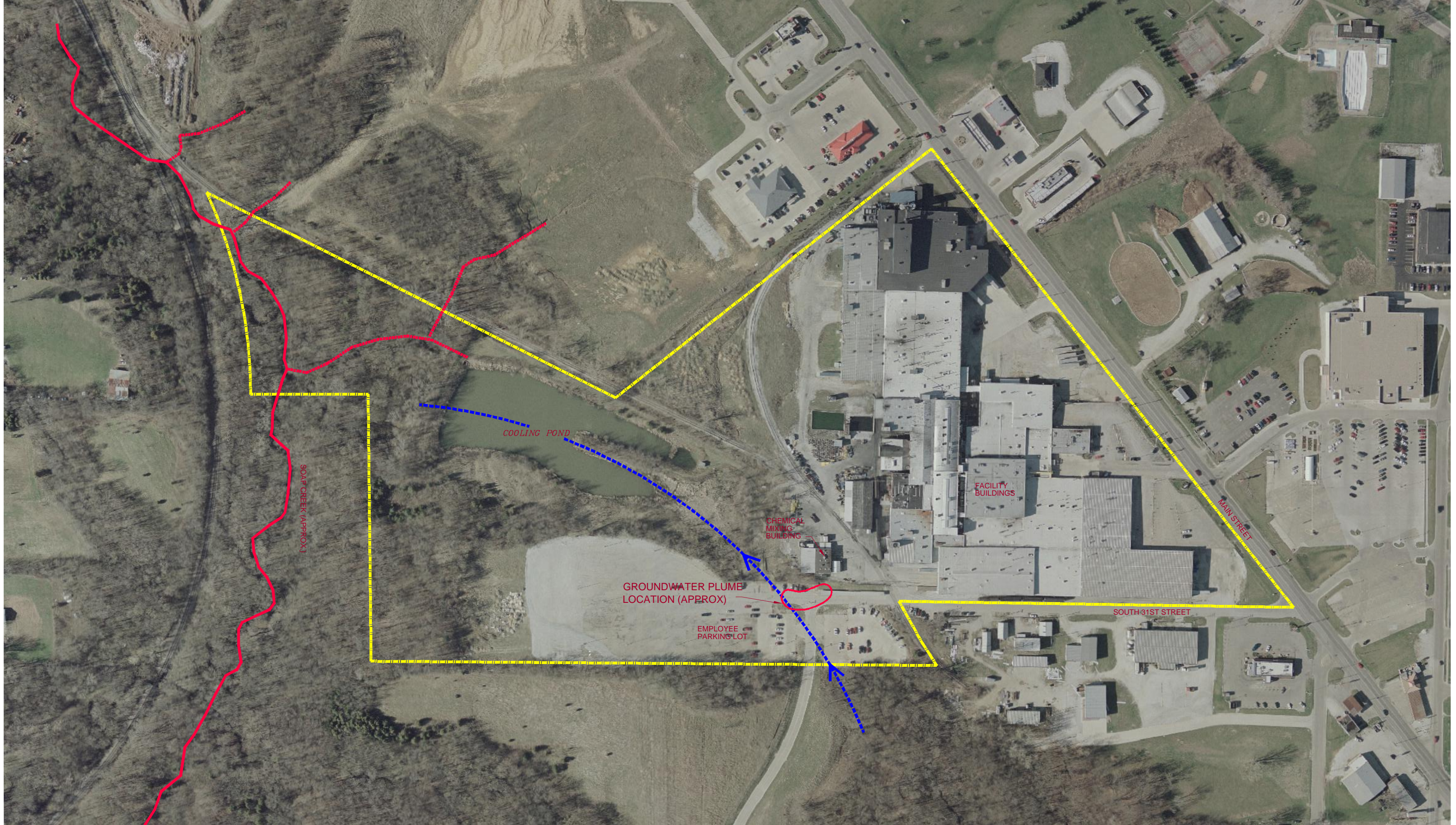
Notes:

BOLD - Compound not detected above Detection Limit (DL). DL value used in the statistical test.

Blank Data Box - Compound not analyzed during sampling event.

APPENDIX D

CD with Laboratory Analytical Data Reports and Report Drawings

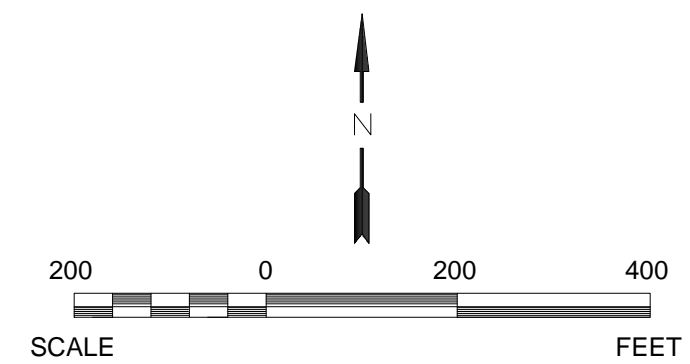


LEGEND:

- APPROXIMATE LOCATION OF CURRENT SURFACE DRAINAGE FEATURES
- APPROXIMATE LOCATION OF HISTORIC SURFACE DRAINAGE FEATURES
- APPROXIMATE LOCATION OF SOAP CREEK (DASHED LINES INDICATE EPHEMERAL DRAINAGES)
- APPROXIMATE LOCATION OF PROPERTY LINE

NOTE:

AERIAL PHOTOGRAPH TAKEN IN 2001.



URS

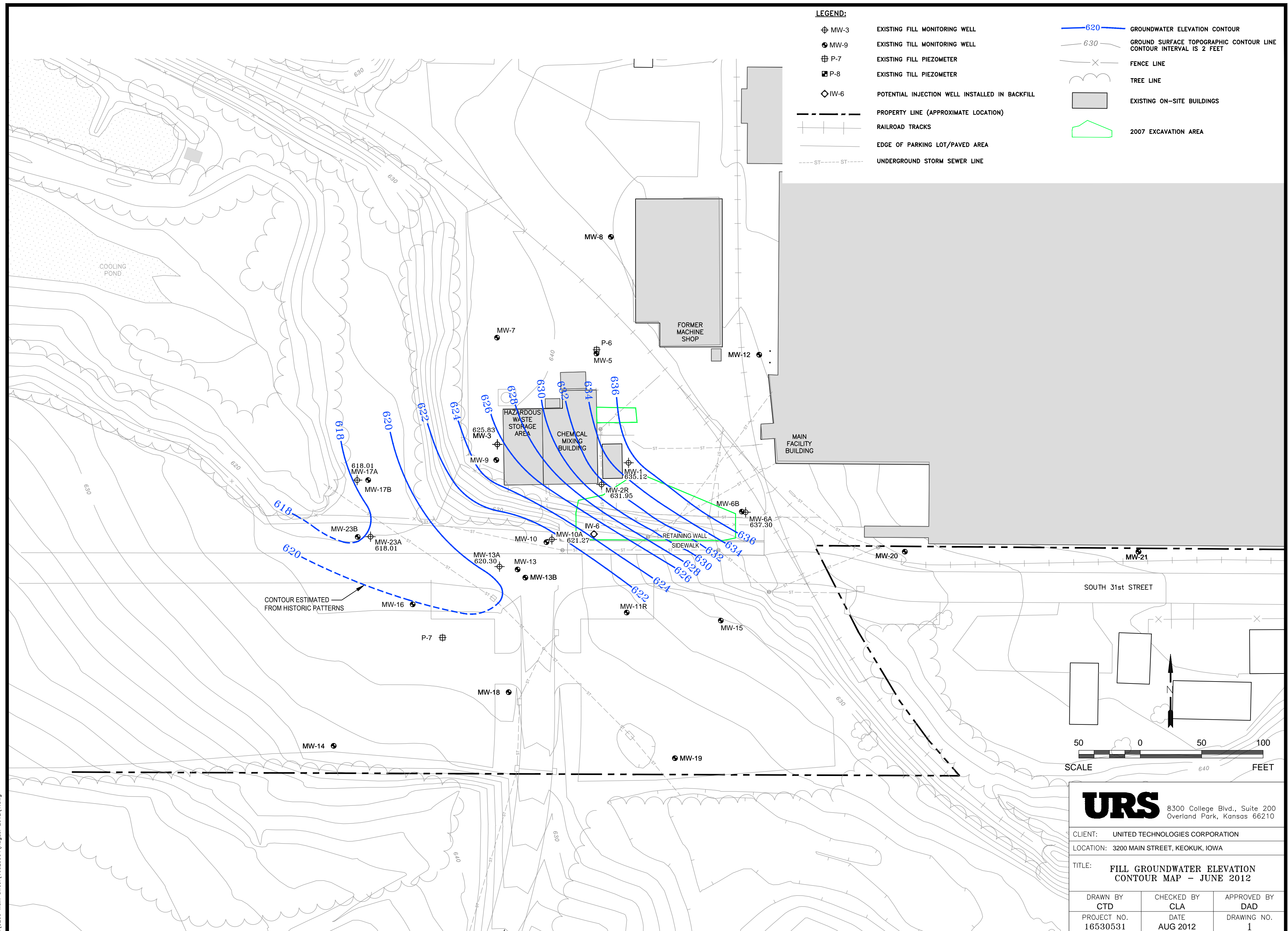
8300 College Blvd., Suite 200
Overland Park, Kansas 66210

CLIENT: UNITED TECHNOLOGIES CORPORATION

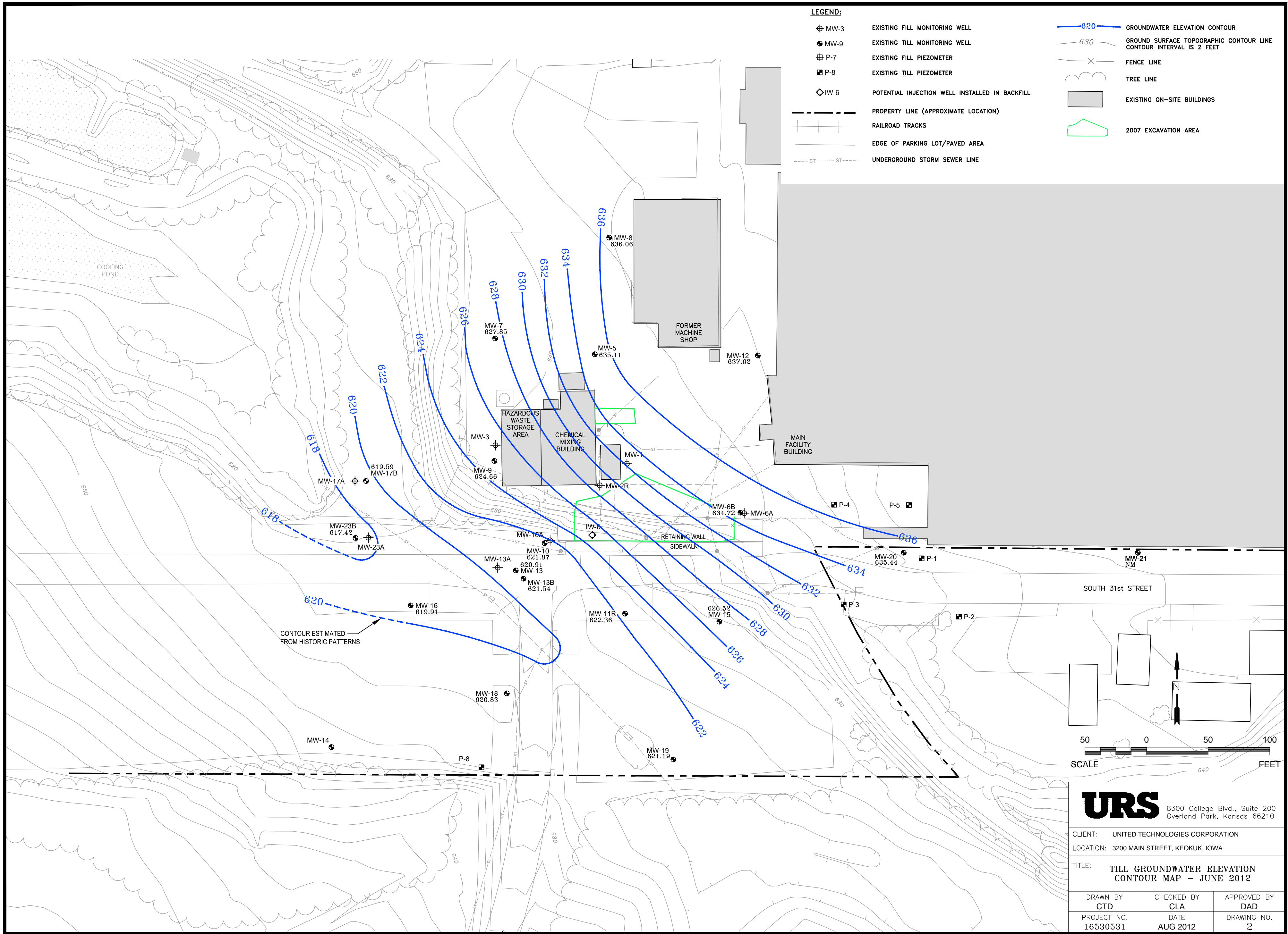
LOCATION: 3200 MAIN STREET, KEOKUK, IOWA

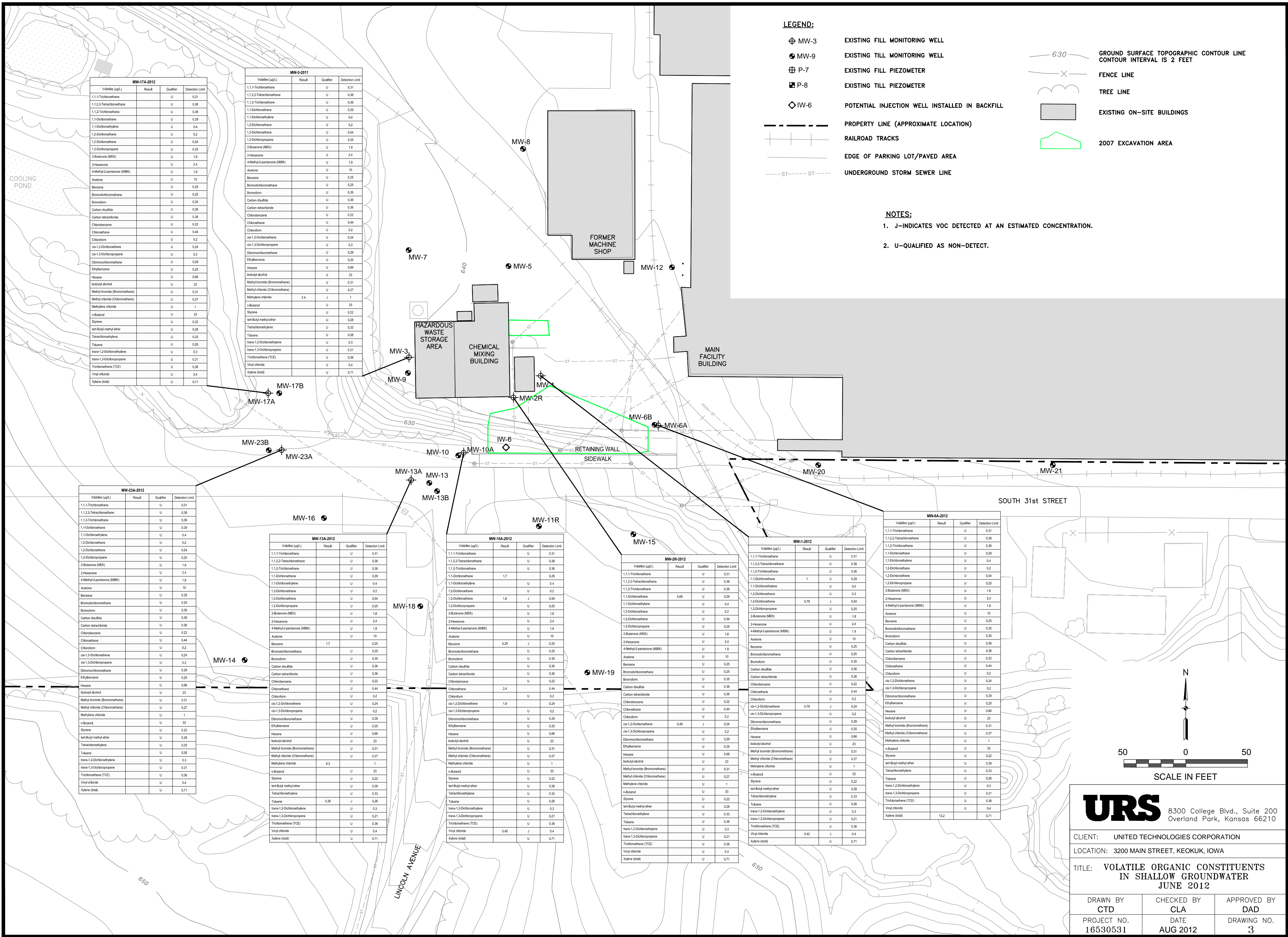
TITLE: PROPERTY LINE AND
FACILITY LAYOUT

DRAWN BY CTD	CHECKED BY CLA	APPROVED BY DAD
PROJECT NO. 16530531	DATE AUG 2012	DRAWING NO. COVER



August 13, 2012 1:50:40 pm (cro)
J:\3200 Main Street\165290A\August 2012\2.dwg





MW-17B-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	U	U	0.31	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1-Dichloroethane	U	U	0.29	
1,1-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.54	
1,2-Dichloropropane	U	U	0.25	
2-Butanone (MEK)	U	U	1.8	
2-Heptanone	U	U	2.4	
4-Methyl-2-pentanone (MIBK)	U	U	1.9	
Axetone	U	U	10	
Benzene	U	U	0.25	
Bromodichloromethane	U	U	0.25	
Bromomethane	U	U	0.35	
Carbon disulfide	U	U	0.36	
Carbon tetrachloride	U	U	0.36	
Chlorobenzene	U	U	0.22	
Chloroethane	U	U	0.44	
Chloroform	U	U	0.2	
cis-1,2-Dichloroethane	U	U	0.24	
cis-1,3-Dichloropropane	U	U	0.2	
Dibromochloromethane	U	U	0.29	
Ethylbenzene	U	U	0.25	
Heptane	U	U	0.66	
Isobutyl alcohol	U	U	23	
Methyl bromide (Bromomethane)	U	U	0.31	
Methyl chloride (Chloromethane)	U	U	0.27	
Methylene chloride	U	U	1	
n-Butanol	U	U	33	
Styrene	U	U	0.22	
tert-Butyl methyl ether	U	U	0.28	
Tetrahydrofuran	U	U	0.33	
Toluene	U	U	0.26	
trans-1,2-Dichloroethane	U	U	0.3	
trans-1,3-Dichloropropane	U	U	0.21	
Trichloroethene (TCE)	U	U	0.36	
Vinyl chloride	0.45	J	0.4	
Xylene (total)	U	U	0.71	

MW-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	U	U	0.31	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1-Dichloroethane	0.47	J	0.29	
1,1-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	0.94	J	0.2	
1,2-Dichloroethane	100	U	0.54	
1,2-Dichloropropane	U	U	0.25	
2-Butanone (MEK)	U	U	1.8	
2-Heptanone	U	U	2.4	
4-Methyl-2-pentanone (MIBK)	U	U	1.9	
Axetone	U	U	10	
Benzene	U	U	0.25	
Bromodichloromethane	U	U	0.25	
Bromomethane	U	U	0.35	
Carbon disulfide	U	U	0.36	
Carbon tetrachloride	U	U	0.36	
Chlorobenzene	U	U	0.22	
Chloroethane	U	U	0.44	
Chloroform	U	U	0.2	
cis-1,2-Dichloroethane	2	U	0.24	
cis-1,3-Dichloropropane	96.5	U	0.2	
Dibromochloromethane	U	U	0.29	
Ethylbenzene	U	U	0.25	
Heptane	U	U	0.66	
Isobutyl alcohol	U	U	23	
Methyl bromide (Bromomethane)	U	U	0.31	
Methyl chloride (Chloromethane)	U	U	0.27	
Methylene chloride	U	U	1	
n-Butanol	U	U	33	
Styrene	U	U	0.22	
tert-Butyl methyl ether	U	U	0.28	
Tetrahydrofuran	4.9	U	0.33	
Toluene	U	U	0.26	
trans-1,2-Dichloroethane	1.5	U	0.3	
trans-1,3-Dichloropropane	U	U	0.21	
Trichloroethene (TCE)	15.9	U	0.36	
Vinyl chloride	7.4	U	0.4	
Xylene (total)	U	U	0.71	

LEGEND:

- MW-3 EXISTING FILL MONITORING WELL
- MW-9 EXISTING TILL MONITORING WELL
- P-7 EXISTING FILL PIEZOMETER
- P-8 EXISTING TILL PIEZOMETER
- IW-6 POTENTIAL INJECTION WELL INSTALLED IN BACKFILL
- PROPERTY LINE (APPROXIMATE LOCATION)
- RAILROAD TRACKS
- EDGE OF PARKING LOT/PAVED AREA
- UNDERGROUND STORM SEWER LINE

- 6.30 GROUND SURFACE TOPOGRAPHIC CONTOUR LINE
CONTOUR INTERVAL IS 2 FEET
- FENCE LINE
- TREE LINE
- EXISTING ON-SITE BUILDINGS
- 2007 EXCAVATION AREA

NOTES:

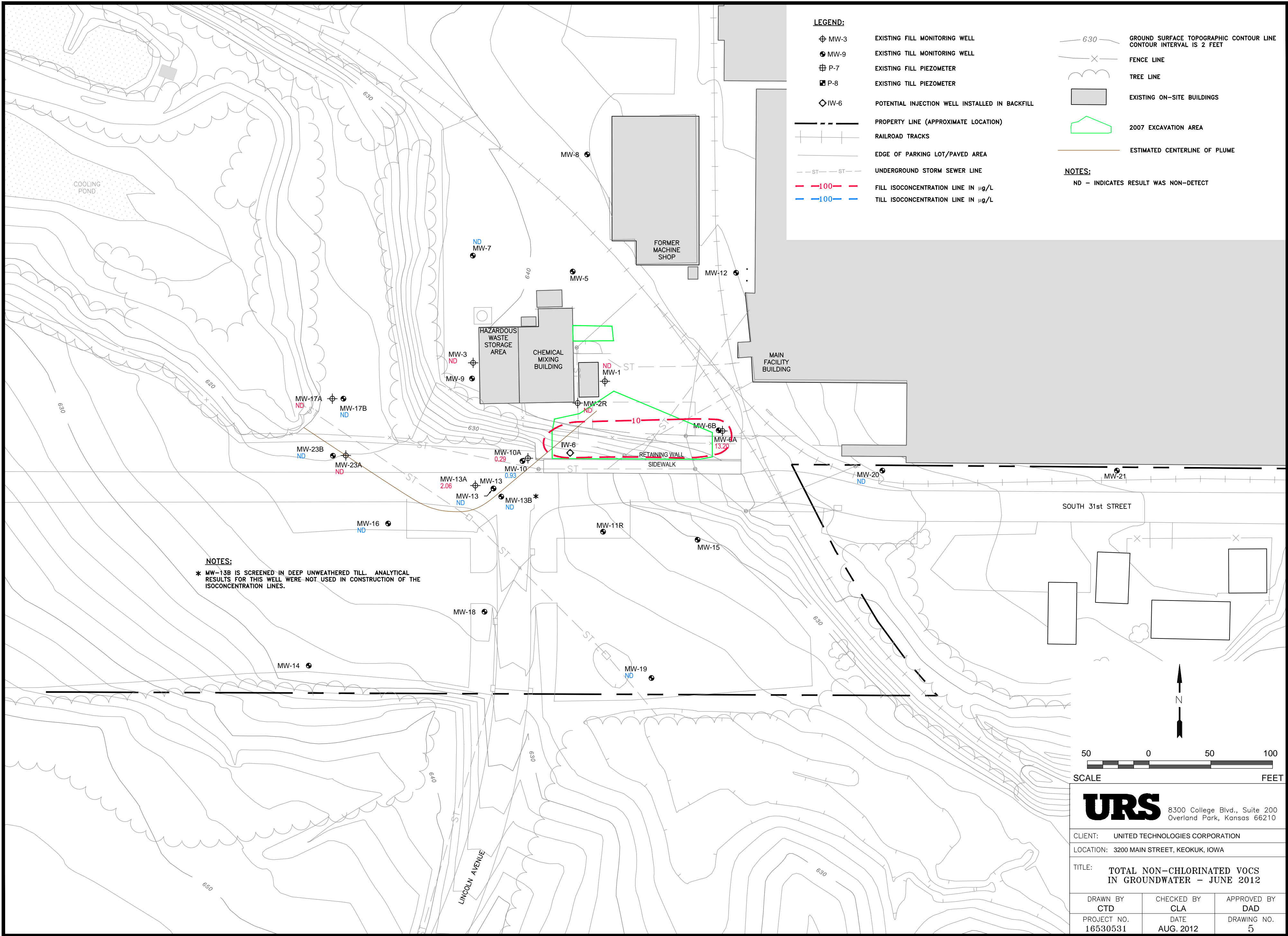
- J-INDICATES VOC DETECTED AT AN ESTIMATED CONCENTRATION.
- U-QUALIFIED AS NON-DETECT.

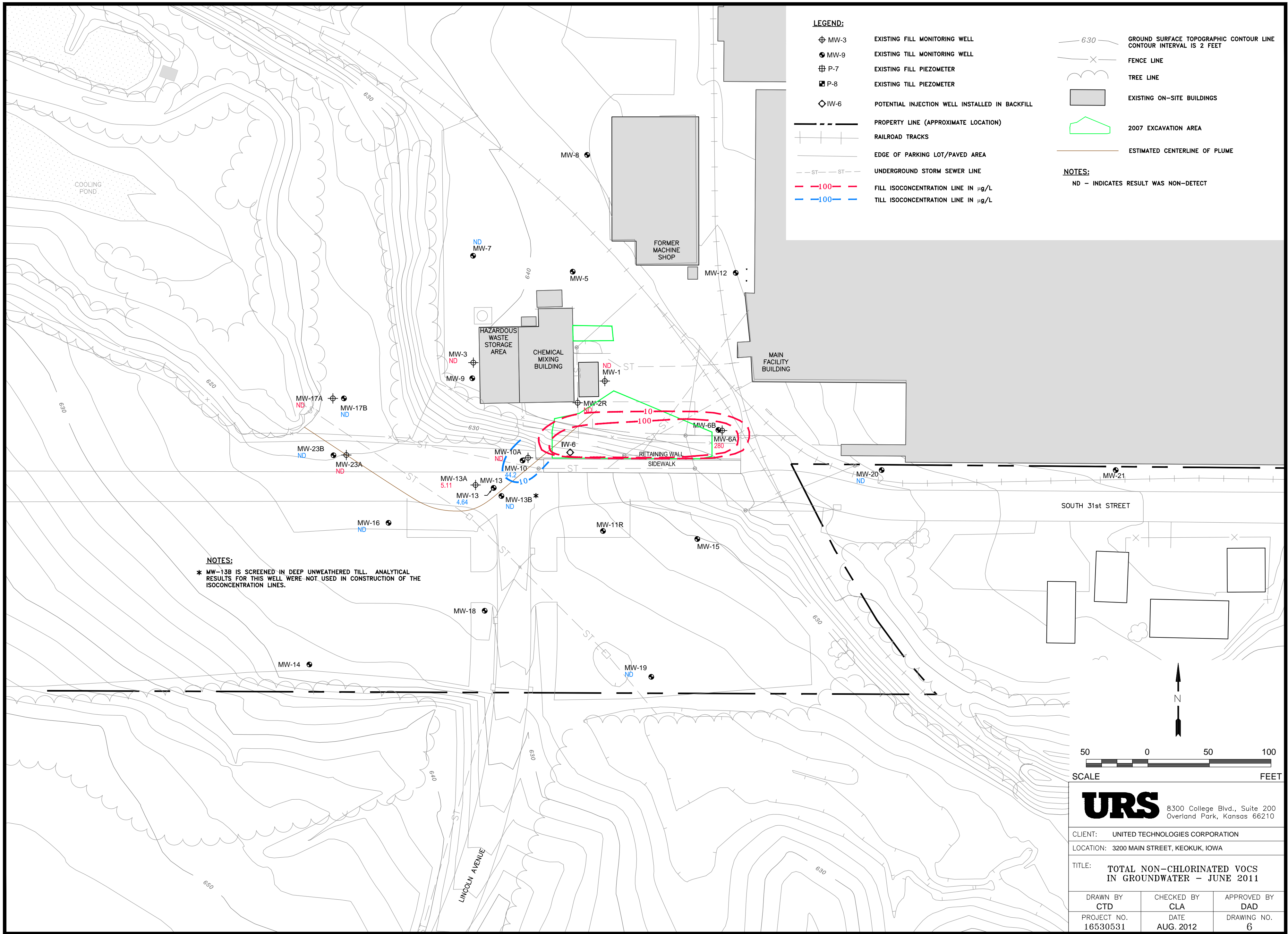
MW-23B-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	U	U	0.31	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1-Dichloroethane	U	U	0.29	
1,1-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.54	
1,2-Dichloropropane	U	U	0.25	
2-Butanone (MEK)	U	U	1.8	
2-Heptanone	U	U	2.4	
4-Methyl-2-pentanone (MIBK)	U	U	1.9	
Axetone	U	U	10	
Benzene	U	U	0.25	
Bromodichloromethane	U	U	0.25	
Bromomethane	U	U	0.35	
Carbon disulfide	U	U	0.36	
Carbon tetrachloride	U	U	0.36	
Chlorobenzene	U	U	0.22	
Chloroethane	U	U	0.44	
Chloroform	U	U	0.2	
cis-1,2-Dichloroethane	U	U	0.24	
cis-1,3-Dichloropropane	U	U	0.2	
Dibromochloromethane	U	U	0.29	
Ethylbenzene	U	U	0.25	
Heptane	U	U	0.66	
Isobutyl alcohol	U	U	23	
Methyl bromide (Bromomethane)	U	U	0.31	
Methyl chloride (Chloromethane)	U	U	0.27	
Methylene chloride	U	U	1	
n-Butanol	U	U	33	
Styrene	U	U	0.22	
tert-Butyl methyl ether	U	U	0.28	
Tetrahydrofuran	U	U	0.33	
Toluene	U	U	0.26	
trans-1,2-Dichloroethane	U	U	0.3	
trans-1,3-Dichloropropane	U	U	0.21	
Trichloroethene (TCE)	U	U	0.36	
Vinyl chloride	U	U	0.4	
Xylene (total)	U	U	0.71	

MW-16-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	U	U	0.31	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1-Dichloroethane	U	U	0.29	
1,1-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.2	
1,2-Dichloroethane	U	U	0.54	
1,2-Dichloropropane	U	U	0.25	
2-Butanone (MEK)	U	U	1.8	
2-Heptanone	U	U	2.4	
4-Methyl-2-pentanone (MIBK)	U	U	1.9	
Axetone	U	U	10	
Benzene	U	U	0.25	
Bromodichloromethane	U	U	0.25	
Bromomethane	U	U	0.35	
Carbon disulfide	U	U	0.36	
Carbon tetrachloride	U	U	0.36	
Chlorobenzene	U	U	0.22	
Chloroethane	U	U	0.44	
Chloroform	U	U	0.2	
cis-1,2-Dichloroethane	U	U	0.24	
cis-1,3-Dichloropropane	U	U	0.2	
Dibromochloromethane	U	U	0.29	
Ethylbenzene	U	U	0.25	
Heptane	U	U	0.66	
Isobutyl alcohol	U	U	23	
Methyl bromide (Bromomethane)	U	U	0.31	
Methyl chloride (Chloromethane)	U	U	0.27	
Methylene chloride	U	U	1	
n-Butanol	U	U	33	
Styrene	U	U	0.22	
tert-Butyl methyl ether	U	U	0.28	
Tetrahydrofuran	U	U	0.33	
Toluene	U	U	0.26	
trans-1,2-Dichloroethane	U	U	0.3	
trans-1,3-Dichloropropane	U	U	0.21	
Trichloroethene (TCE)	U	U	0.36	
Vinyl chloride	U	U	0.4	
Xylene (total)	U	U	0.71	

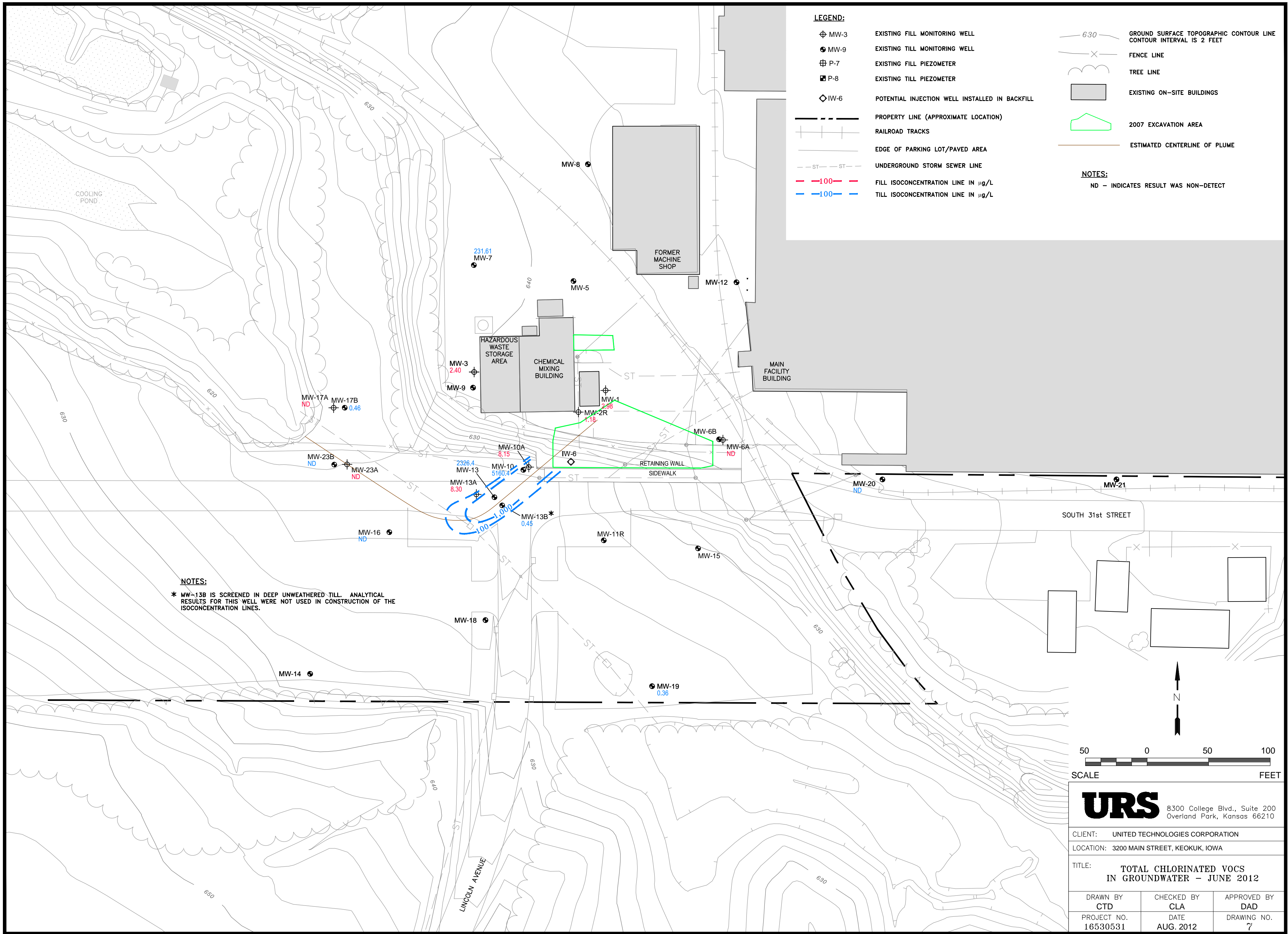
MW-14-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	3.6	J	1.5	
1,1,2-Trichloroethane	U	U	1.9	
1,1,2-Trichloroethane	U	U	1.8	
1,1,2-Trichloroethane	U	U	1.4	
1,1-Dichloroethane	22.3	U	0.98	
1,1-Dichloroethane	42.1	U	2	
1,2-Dichloroethane	88.9	J	2.7	
1,2-Dichloroethane	4.3	J	1.3	
2-Butanone (MEK)	U	U	9.2	
2-Heptanone	U	U	12	
4-Methyl-2-pentanone (MIBK)	U	U	9.3	
Axetone	U	U	90	
Benzene	U	U	1.2	
Bromodichloromethane	U	U	1.3	
Bromomethane	U	U	1.8	
Carbon disulfide	U	U	1.8	
Carbon tetrachloride	U	U	1.8	
Chlorobenzene	U	U	1.1	
Chloroethane	U	U	2.2	
Chloroform	U	U	1	
cis-1,2-Dichloroethane	88.9	U	1.2	
cis-1,3-Dichloropropane	U	U	1	
Dibromochloromethane	U	U	1.4	
Ethylbenzene	U	U	1.3	
Heptane	U	U	3.3	
Isobutyl alcohol	U	U	120	
Methyl bromide (Bromomethane)	U	U	1.6	
Methyl chloride (Chloromethane)	U	U	1.3	
Methylene chloride	1900	J	50	
n-Butanol	U	U	170	
Styrene	U	U	1.1	
tert-Butyl methyl ether	U	U	1.4	
Tetrahydrofuran	92.5	U	1.7	
Toluene	U	U	1.3	
trans-1,2-Dichloroethane	U	U	1.5	
trans-1,3-Dichloropropane	U	U	1.1	
Trichloroethene (TCE)	220	U	1.8	
Vinyl chloride	3.8	J	2	
Xylene (total)	U	U	3.6	

MW-18B-2012				
Volatiles (ug/L)	Result	Qualifier	Detection Limit	
1,1,1-Trichloroethane	U	U	0.31	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1,2-Trichloroethane	U	U	0.36	
1,1-Dichloroethane	U	U	0.29	
1,1-Dichloroethane	U	U	0.4	
1,2-Dichloroethane	U	U	0.2	
1,2-Dichloroethane	U	U	0.54	
1,2-Dichloropropane	U	U	0.25	
2-Bromoethane (MEB)	U	U	1.8	
2-Heptanone	U	U	2.4	
4-Methyl-2-pentanone (MIBK)	U	U	1.9	
Acetone	U	U	10	
Benzene	U	U	0.25	
Bromodichloromethane	U	U	0.25	
Bromodimethane	U	U	0.35	
Carbon disulfide	U	U	0.36	
Carbon tetrachloride	U	U	0.36	
Chlorobenzene	U	U	0.22	
Chlorobenzene	U	U	0.44	
Chloroform	U	U	0.2	
cis-1,2-Dichloroethane	U	U	0.24	
cis-1,2-Dichloroethane	U	U	0.2	
Dichlorodimethane	U	U	0.29	
Ethylbenzene	U	U	0.25	
Heptane	U	U	0.66	
Methyl acetate	U	U	79	
Methyl isobutyl carbinol (Bromotoluene)	U	U	0.31	
Methyl nitrate (Chlorobenzene)	U	U	0.27	
Methoxychloride	U	U	1	
n-Butanol	U	U	39	
Styrene	U	U	0.22	
tert-Butyl methyl ether	U	U	0.38	
Tetrachloroethane	U	U	0.33	
Toluene	U	U	0.26	
trans-1,2-Dichloroethane	U	U	0.3	
trans-1,2-Dichloropropane	U	U	0.21	
Trichloroethylene (TCE)	0.45	U	0.36	
Vinyl chloride	U	U	0.4	
Xylene (Bz)	U	U	0.71	

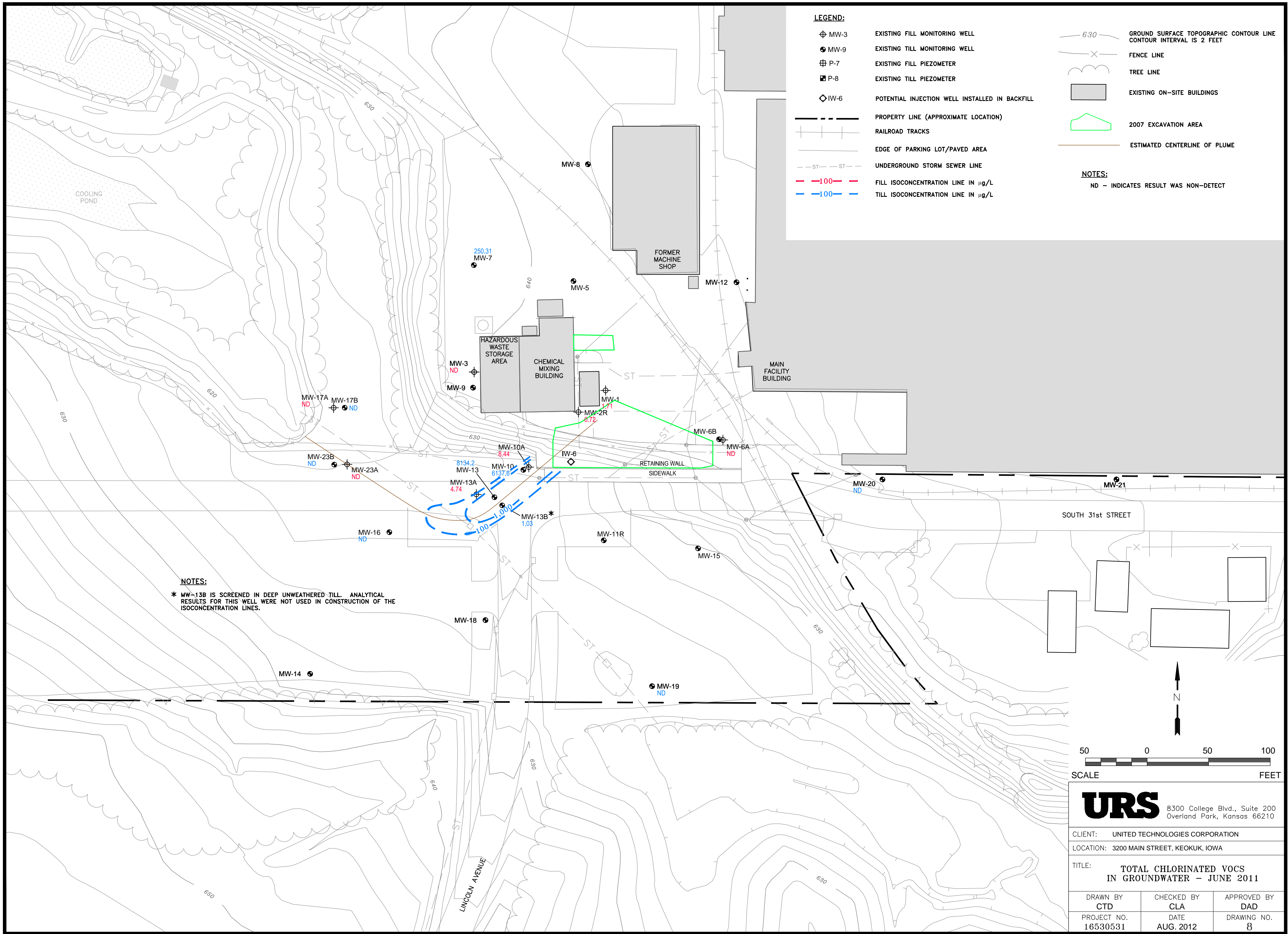


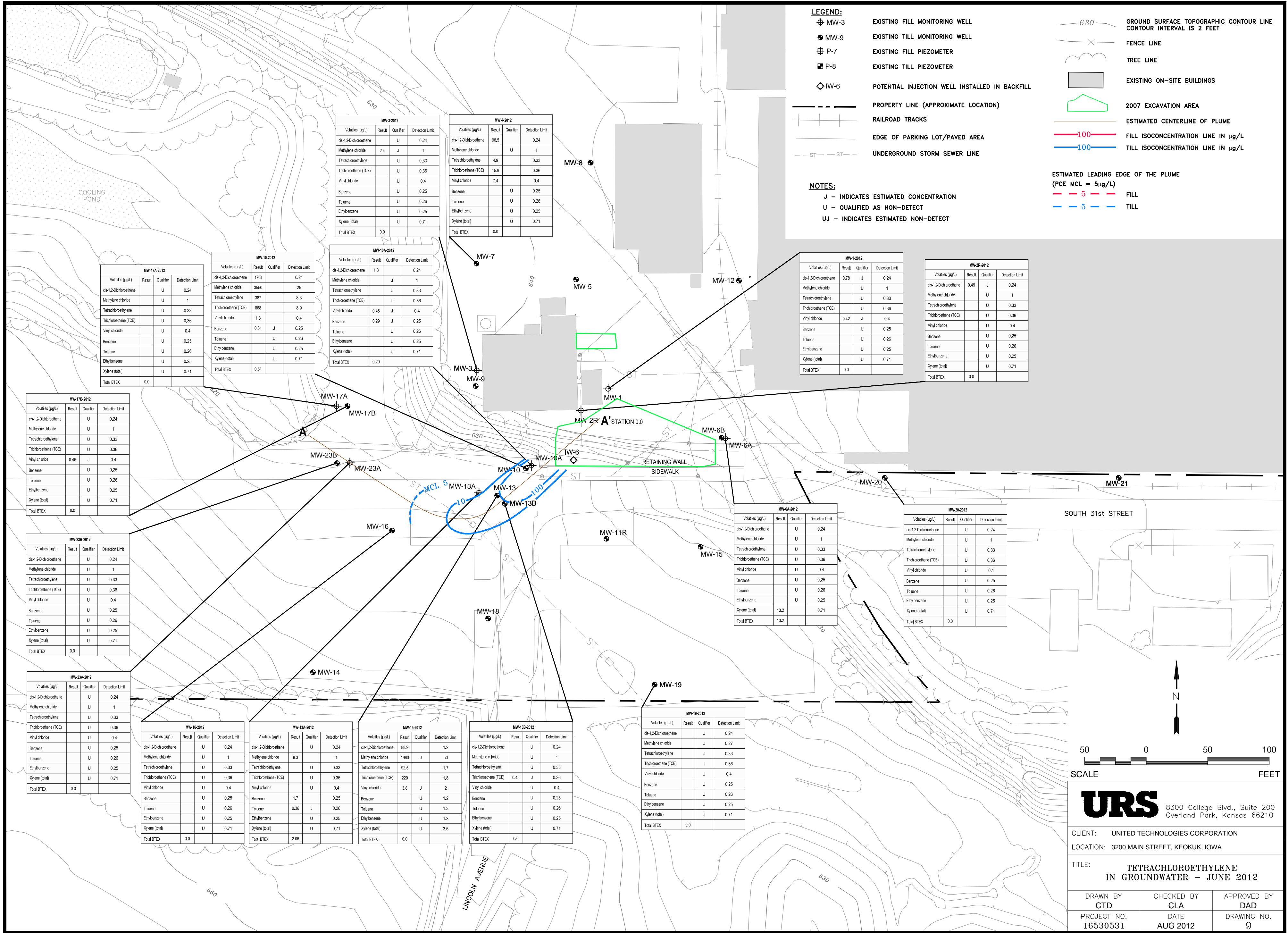


August 13, 2012 2:11:32 pm (cro)
J:\3200 Main Street\165290A\August 2012\7.dwg



August 13, 2012 2:13:42 pm (cro)
J:\3200 Main Street\165290A\August 2012\8.dwg





URS

8300 College Blvd., Suite 200
Overland Park, Kansas 66210

CLIENT: UNITED TECHNOLOGIES CORPORATION

LOCATION: 3200 MAIN STREET, KEOKUK, IOWA

TITLE: TETRACHLOROETHYLENE
IN GROUNDWATER - JUNE 2012

DRAWN BY
CTD

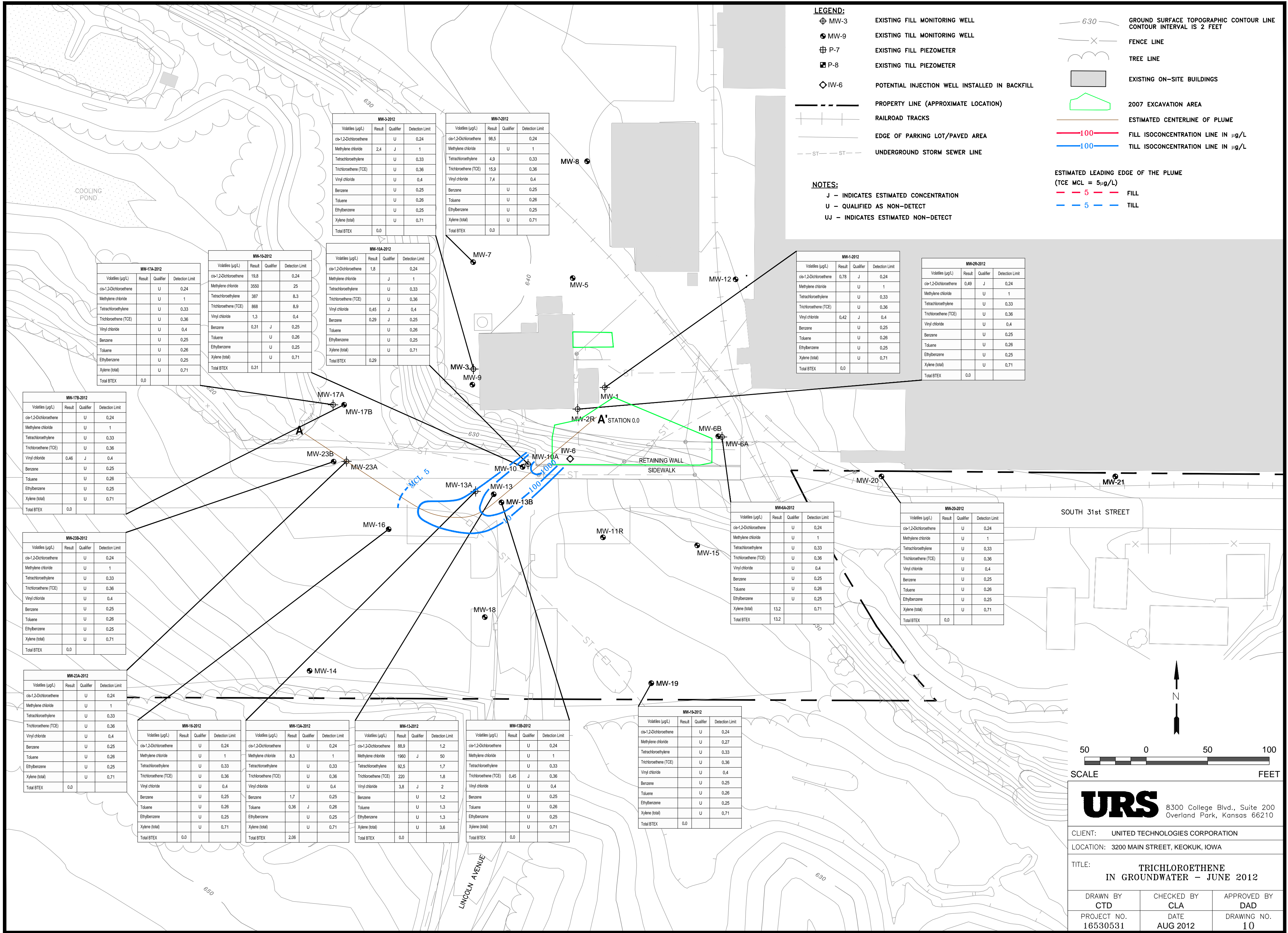
CHECKED BY
CLA

APPROVED BY
DAD

PROJECT NO.
16530531

DATE
AUG 2012

DRAWING NO.
9



URS

8300 College Blvd., Suite 200
Overland Park, Kansas 66210

CLIENT: UNITED TECHNOLOGIES CORPORATION

LOCATION: 3200 MAIN STREET, KEOKUK, IOWA

TITLE: TRICHLOROETHENE
IN GROUNDWATER - JUNE 2012

DRAWN BY
CTD

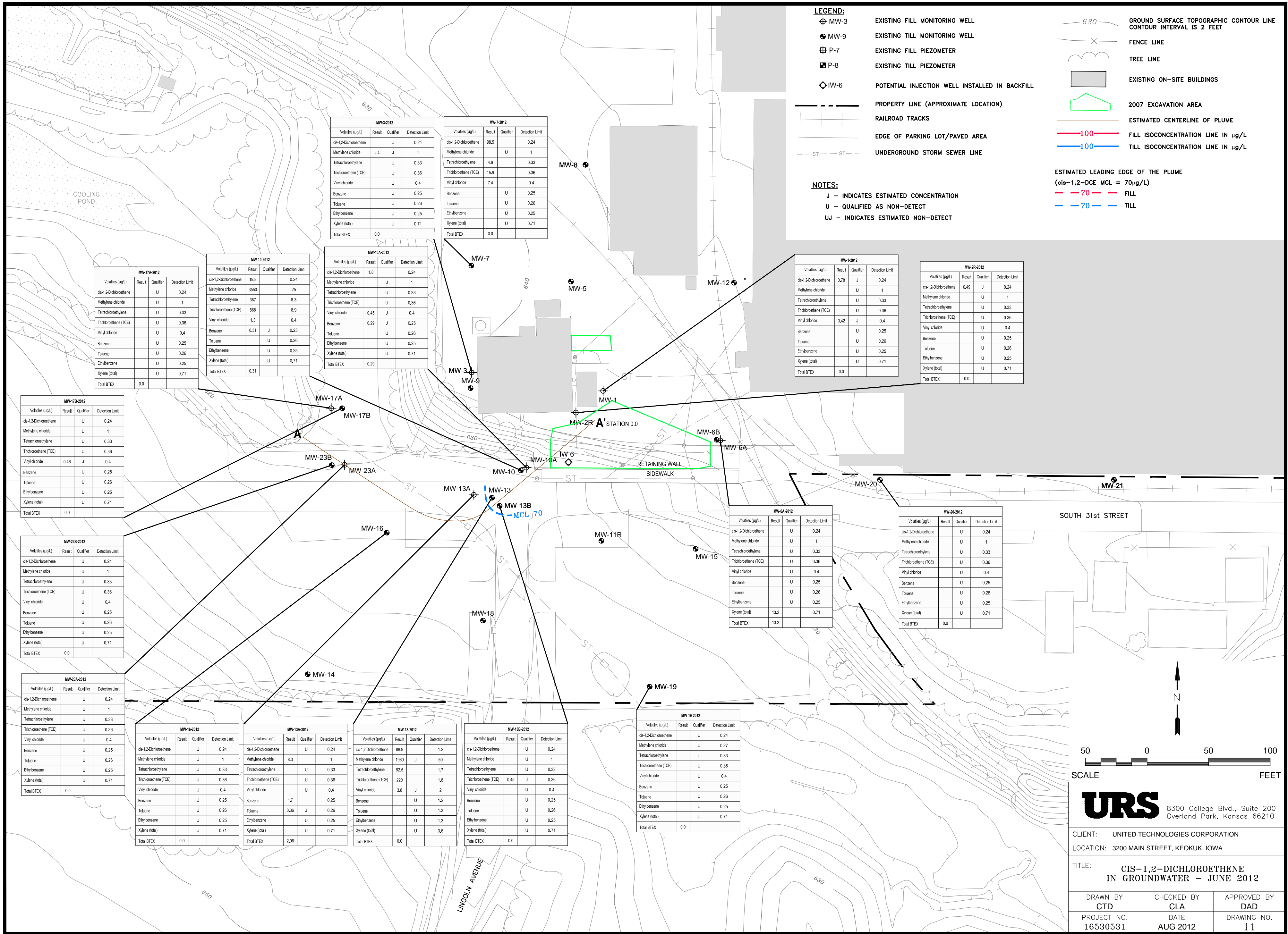
CHECKED BY
CLA

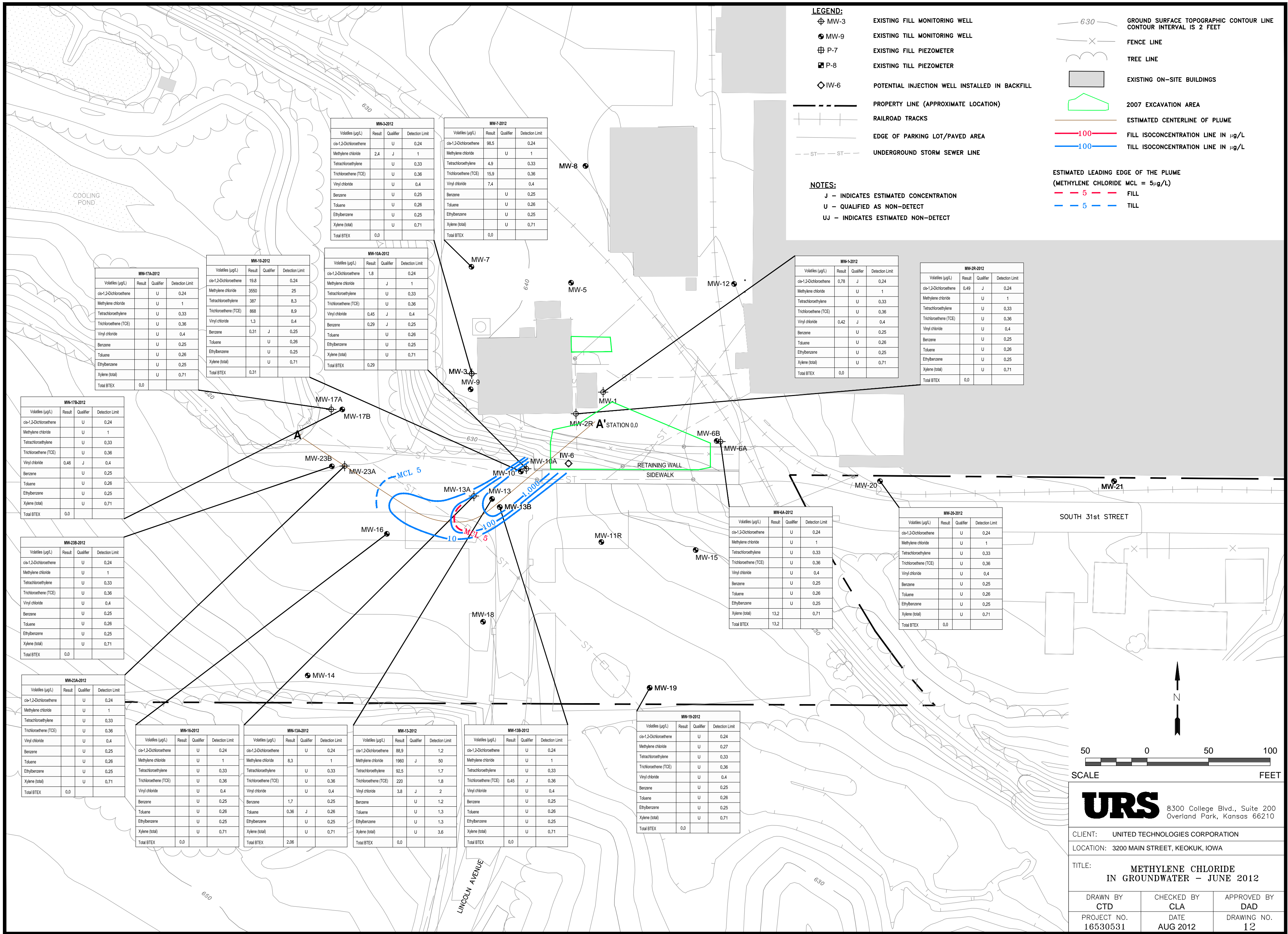
APPROVED BY
DAD

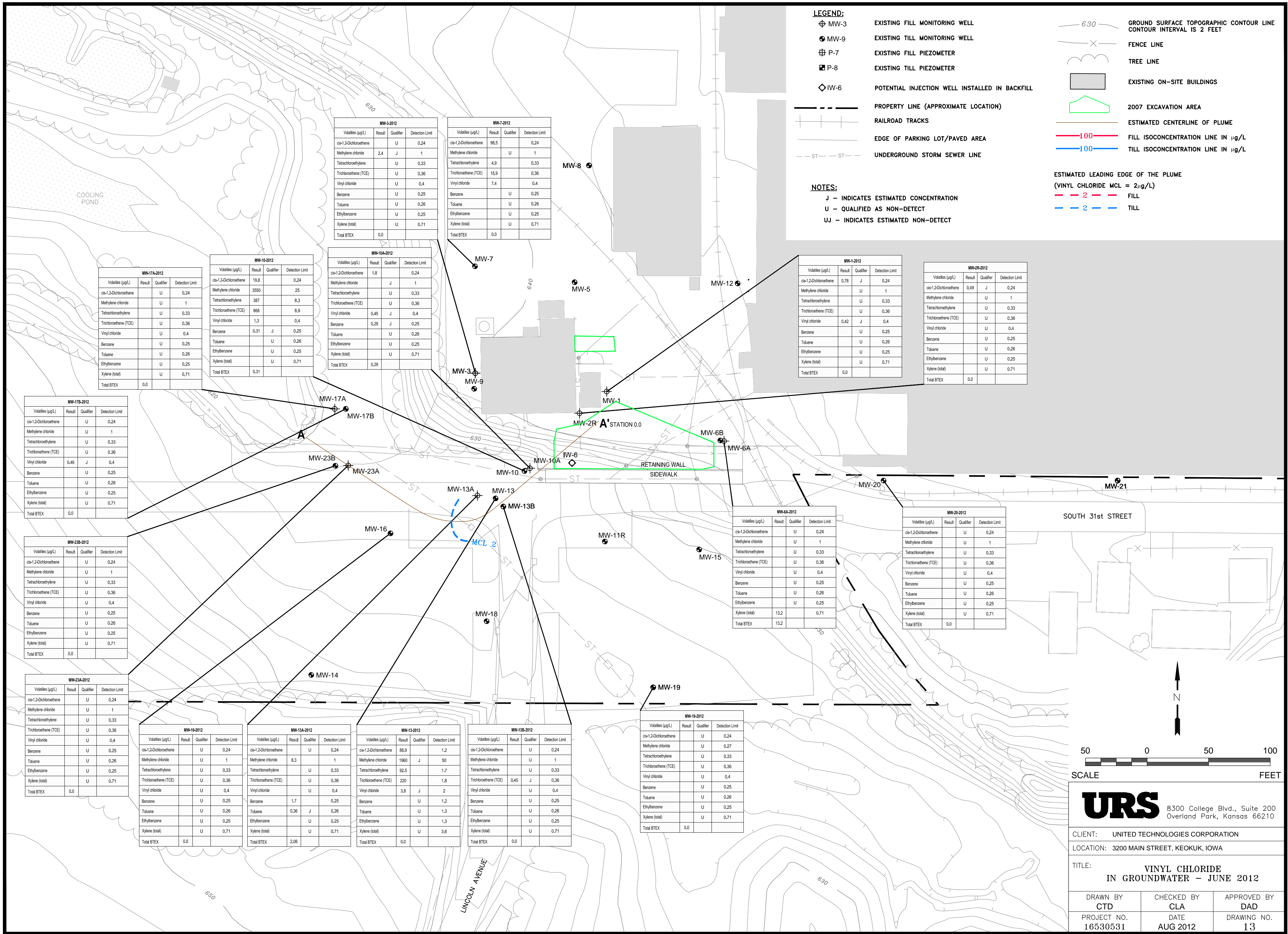
PROJECT NO.
16530531

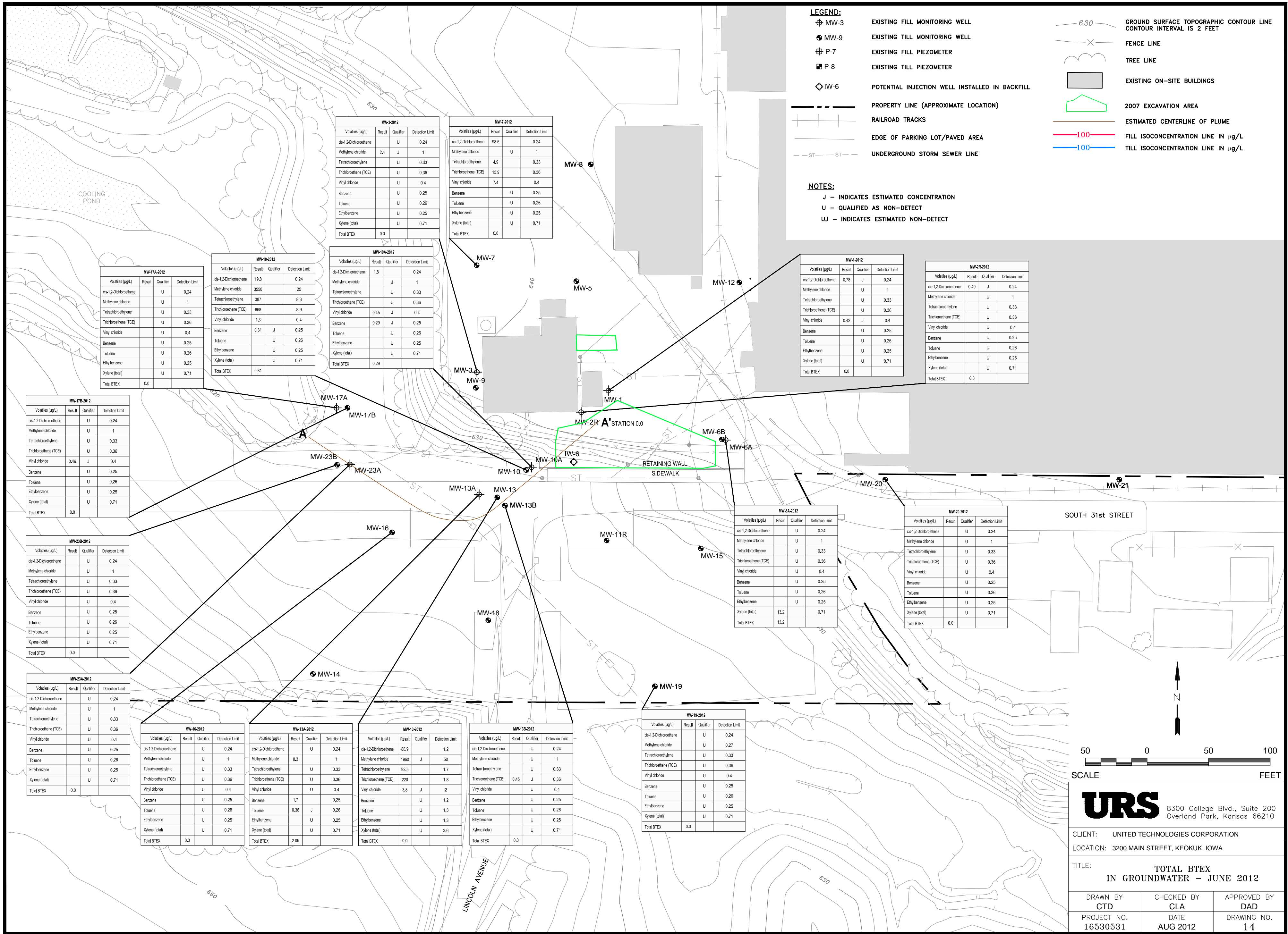
DATE
AUG 2012

DRAWING NO.
10

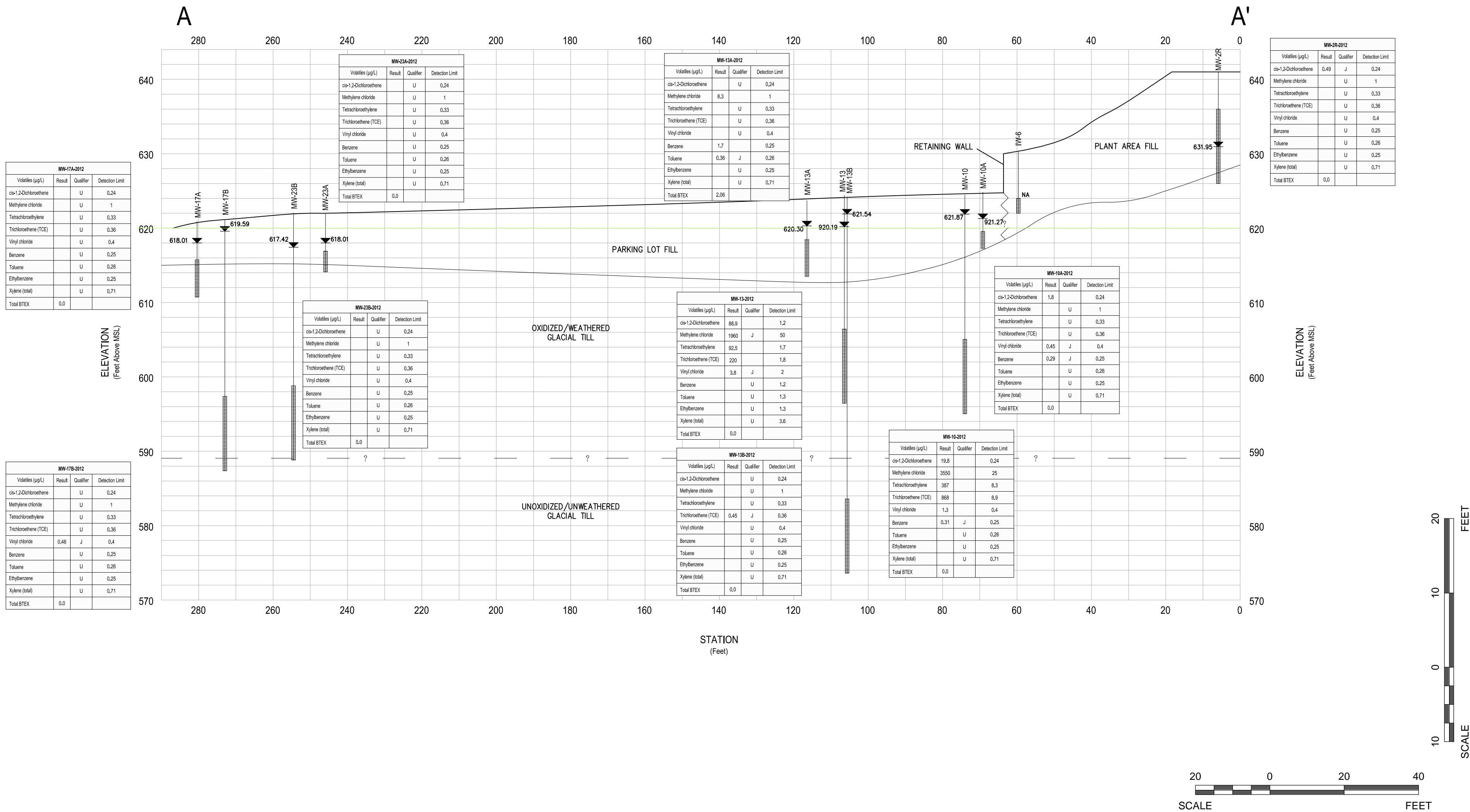








CROSS-SECTION A-A'



LEGEND:

- ▲ STATIC GROUNDWATER LEVEL, JUNE 18, 2012
- MONITORING WELL SCREEN

NOTES:

- J - INDICATES ESTIMATED CONCENTRATION
- U - QUALIFIED AS NON-DETECT
- UJ - INDICATES ESTIMATED NON-DETECT

URS

8300 College Blvd., Suite 200
Overland Park, Kansas 66210

CLIENT: UNITED TECHNOLOGIES CORPORATION

LOCATION: 3200 MAIN STREET, KEOKUK, IOWA

TITLE: CROSS SECTION A-A',
PLUME CENTERLINE WELLS - JUNE 2012

DRAWN BY
CTD

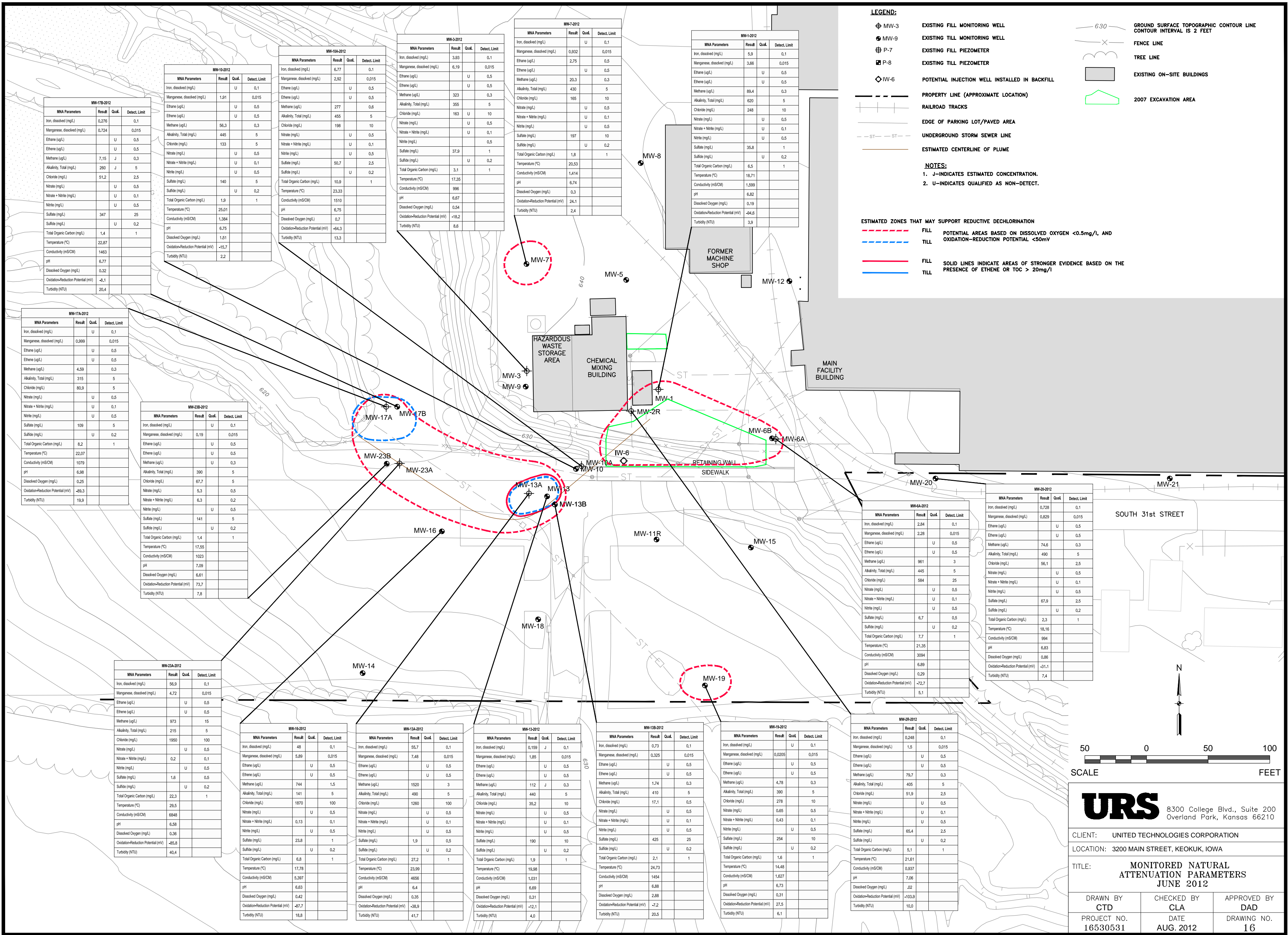
CHECKED BY
CLA

APPROVED BY
DAD

PROJECT NO.
16530531

DATE
AUG 2012

DRAWING NO.
15



URS

8300 College Blvd., Suite 200
Overland Park, Kansas 66210

CLIENT: UNITED TECHNOLOGIES CORPORATION

LOCATION: 3200 MAIN STREET, KEOKUK, IOWA

TITLE: MONITORED NATURAL
ATTENUATION PARAMETERS
JUNE 2012

DRAWN BY
CTD

CHECKED BY
CLA

APPROVED BY
DAD

PROJECT NO.
16530531

DATE
AUG. 2012

DRAWING NO.
16

Distances along the plume centerline Used for plume migration calculations

Facility at 3200 Main Street, Keokuk, Iowa

Notes by David Dods, June 5, 2010

The plume centerline was first plotted in 2007 based on consistent historic plume patterns. That line is shown as the faint brown line on the plume maps. The starting or zero point of the line was set near former well MW-2 so that plume distances would be measured from the same starting point each year.

Well distances along the line from the zero point are:

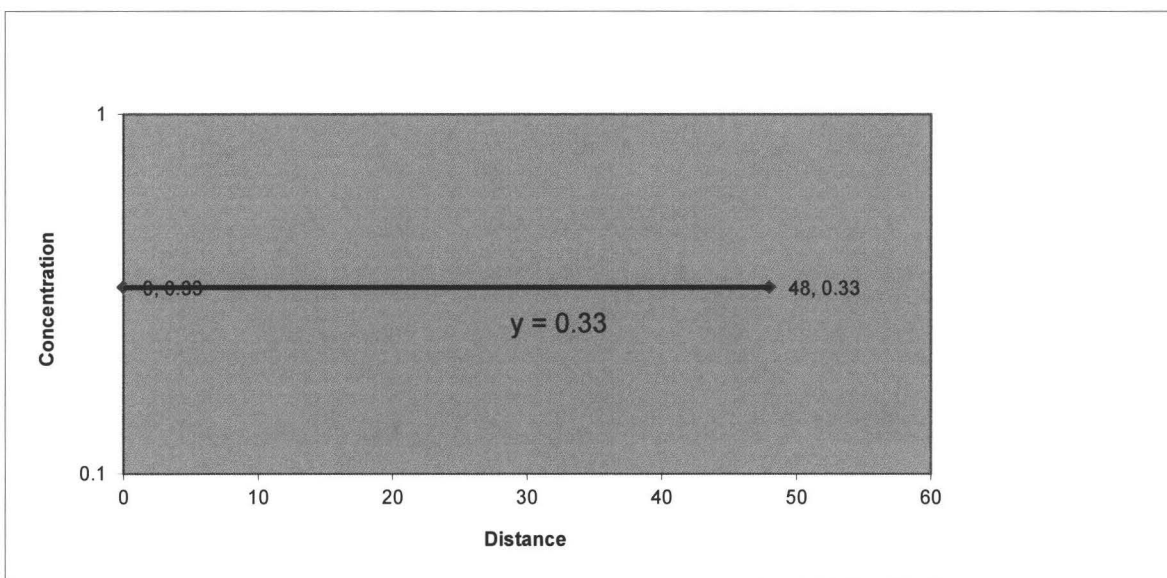
Distance Along Centerline		Distance Between Wells	
Well	ft	Wells	ft
MW-10	72.2	MW-10, MW-13	32.2
MW-10A	67.3	MW-10A, MW-13A	48.4
MW-13	104.4	MW-10, MW-23B	180.1
MW-13A	115.7	MW-10A, MW-23A	176.4
MW-13B	103.8	MW-13, MW-23B	147.9
MW-23A	243.7	MW-13A, MW-23A	128
MW-23B	252.3		

BULK ATTENUATION RATE CALCULATION FOR TETRACHLOROETHYLENE IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A (source)	0	0.33	RL
MW-13A	48	0.33	RL
MW-23A	176	0.33	RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0	0.015	0.0000	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	NA	NA
10	NA	NA
100	NA	NA
1000	NA	NA



Notes:

k - Concentration vs. Distance rate constant

Seepage Velocity - calculated from June 2012 water levels

Retardation Factor - assumed to be 1 to be conservative

RL - Reporting Limit

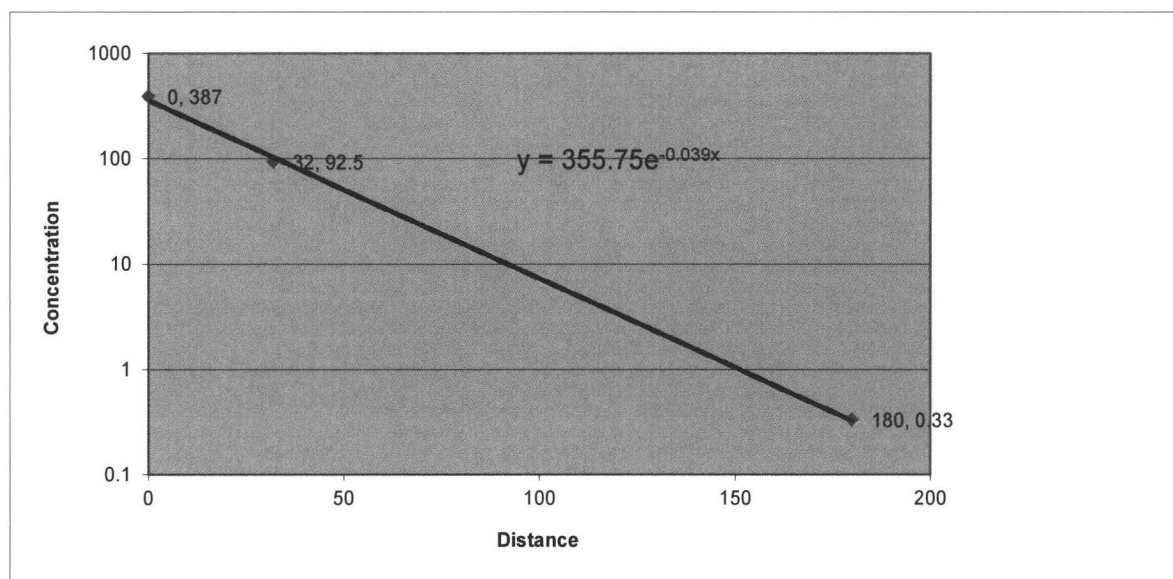
NA - Not applicable, calculated concentration level less than MCL

BULK ATTENUATION RATE CALCULATION FOR TETRACHLOROETHYLENE IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)
MW-10 (source)	0	387
MW-13	32	92.5
MW-23B	180	0.33 RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.039	0.012	0.0005	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	111.51	183.71
10	93.74	165.94
100	34.70	106.90
1000	NA	



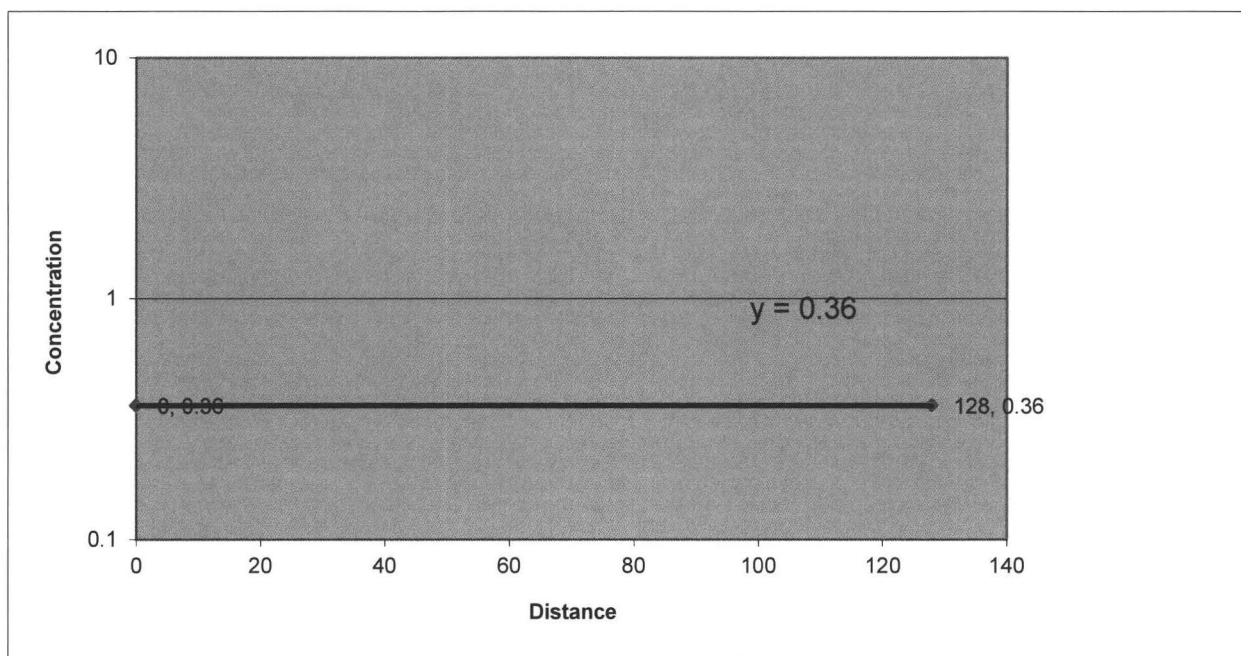
Notes:

- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- J - Concentration is estimated or detected below RL
- The higher result of MW-13 and MW-13 Dup was used
- CL - Centerline
- NA - Not applicable

BULK ATTENUATION RATE CALCULATION FOR TRICHLOROETHENE IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A	NA	0.36	RL
MW-13A (source)	0	0.36	RL
MW-23A	128	0.36	RL
Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0	0.015	0.0000	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	NA	NA
10	NA	NA
100	NA	NA
1000	NA	NA



Notes:

k - Concentration vs. Distance rate constant

Seepage Velocity - calculated from June 2012 water levels

Retardation Factor - assumed to be 1 to be conservative

RL - Reporting Limit

NA - Not applicable

CL - Centerline

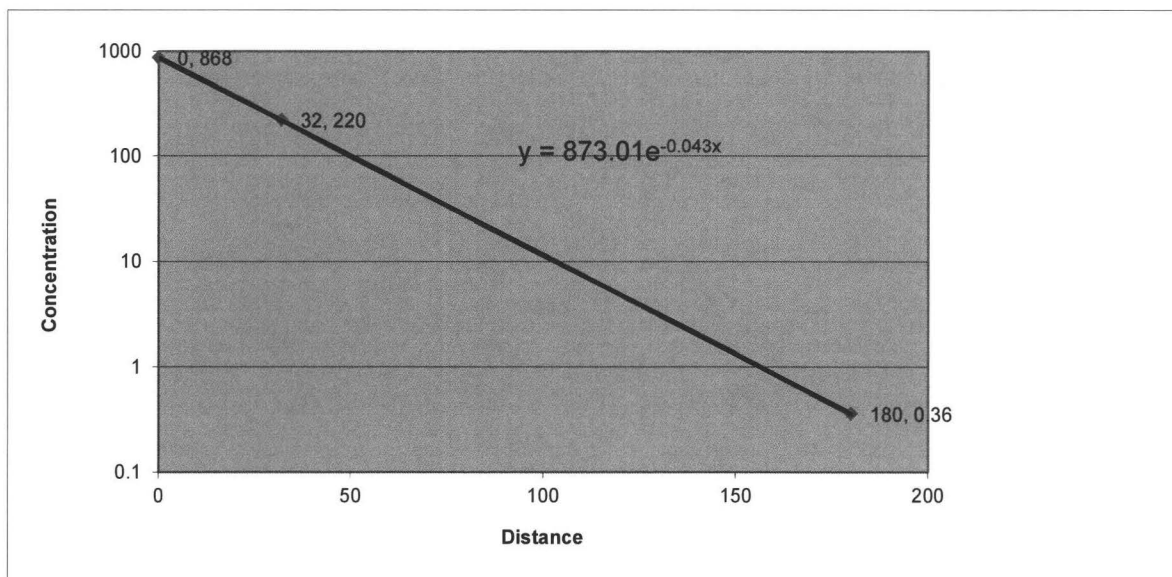
BULK ATTENUATION RATE CALCULATION FOR TRICHLOROETHENE IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)
MW-10 (source)	0	868
MW-13	32	220
MW-23B	180	0.36

RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.043	0.012	0.0005	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	119.92	192.12
10	103.80	176.00
100	50.26	122.46
1000	-3.29	68.91



Notes:

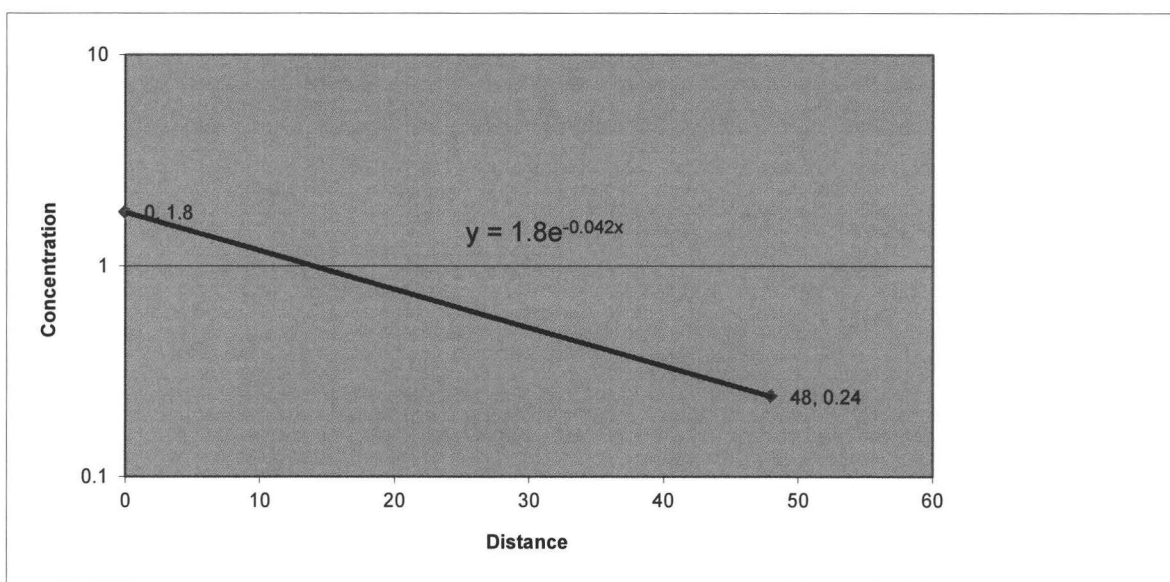
k - Concentration vs. Distance rate constant
 Seepage Velocity - calculated from June 2012 water levels
 Retardation Factor - assumed to be 1 to be conservative
 RL - Reporting Limit
 The higher result of MW-13 and MW-13 Dup was used
 CL - Centerline

BULK ATTENUATION RATE CALCULATION FOR CIS-1, 2-DICHLOROETHYLENE IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A (source)	0	1.8	
MW-13A	48	0.24	RL
MW-23A	176	0.24	RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.042	0.015	0.0006	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
70	NA	NA
100	NA	NA



Notes:

k - Concentration vs. Distance rate constant

Seepage Velocity - calculated from June 2012 water levels

Retardation Factor - assumed to be 1 to be conservative

RL - Reporting Limit

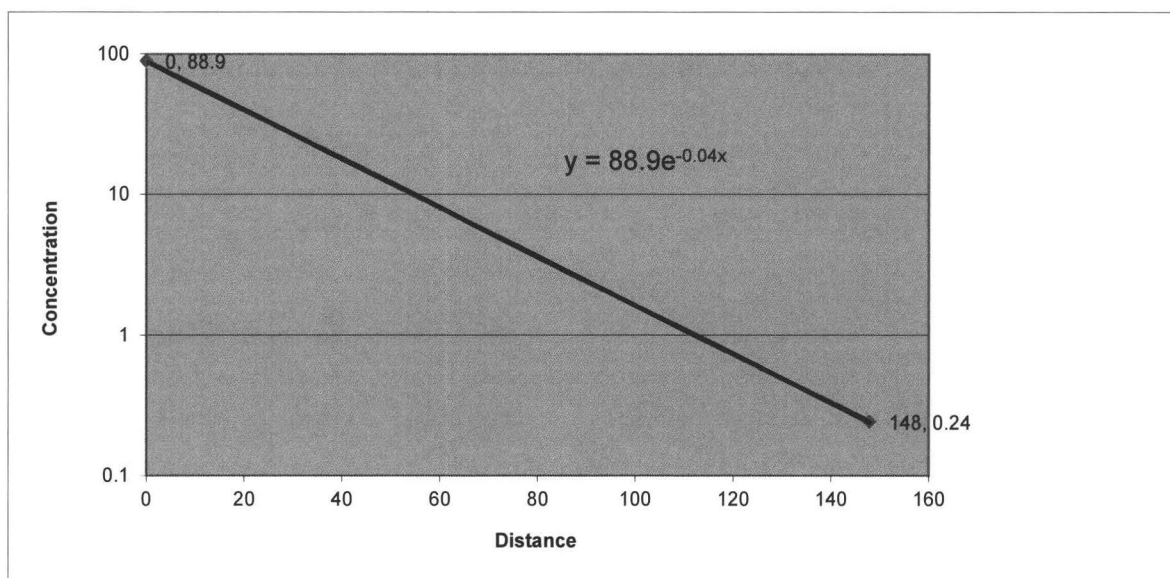
NA - Not applicable, calculated concentration level less than MCL

BULK ATTENUATION RATE CALCULATION FOR CIS-1,2-DICHLOROETHYLENE IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10	NA	19.8	
MW-13 (source)	0	88.9	
MW-23B	148	0.24	RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.04	0.012	0.0005	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
70	5.98	110.38
100	NA	NA
1000	NA	NA



Notes:

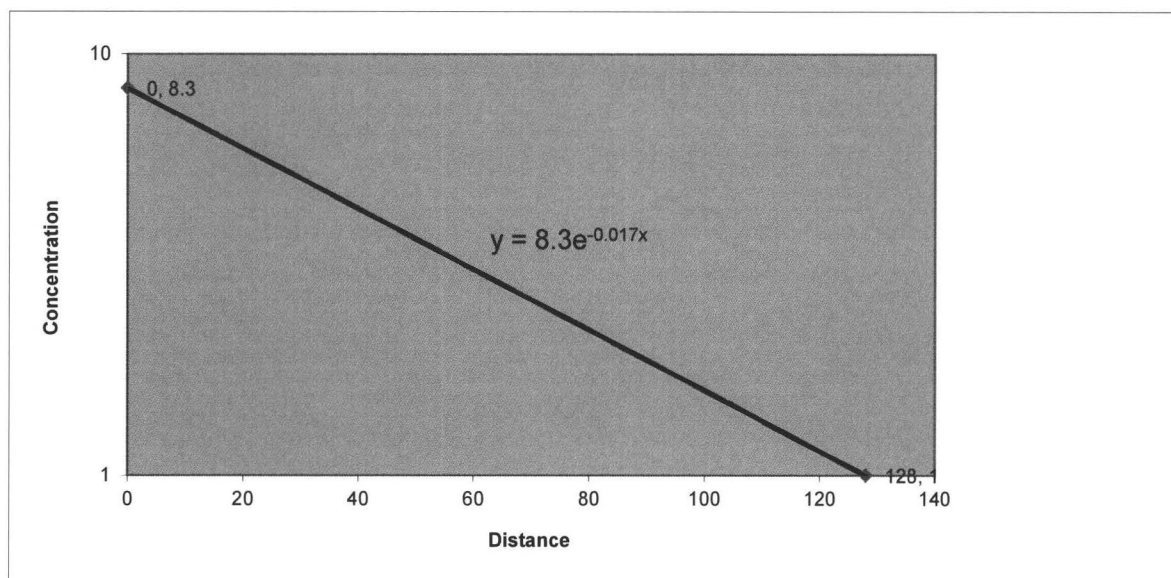
- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- J - Concentration is estimated or detected below RL
- NA - Not applicable
- CL - Centerline
- The higher result of MW-13 and MW-13 Dup was used

BULK ATTENUATION RATE CALCULATION FOR METHYLENE CHLORIDE IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A	NA	1	RL
MW-13A (source)	0	8.3	
MW-23A	128	1	RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.017	0.015	0.0003	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	29.81	145.51
10	NA	NA
100	NA	NA
1000	NA	NA



Notes:

k - Concentration vs. Distance rate constant

Seepage Velocity - calculated from June 2012 water levels

Retardation Factor - assumed to be 1 to be conservative

RL - Reporting Limit

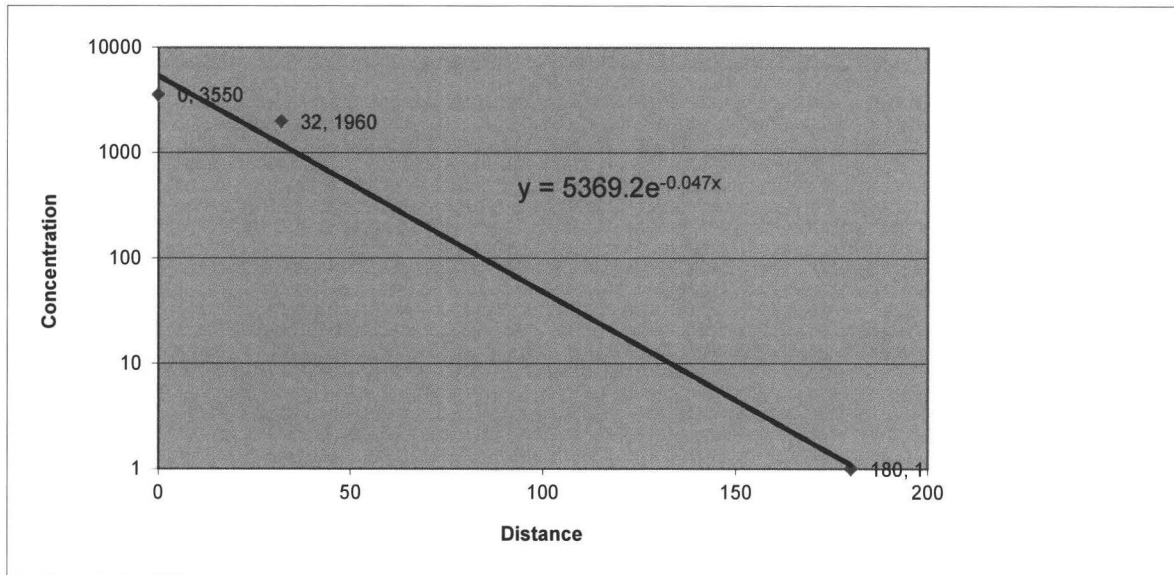
NA - Not applicable, calculated concentration level less than MCL

BULK ATTENUATION RATE CALCULATION FOR METHYLENE CHLORIDE IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)
MW-10 (source)	0	3550
MW-13	32	1960
MW-23B	180	1 RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.047	0.012	0.0006	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	139.69	211.89
10	124.94	197.14
100	75.95	148.15
1000	26.96	99.16



Notes:

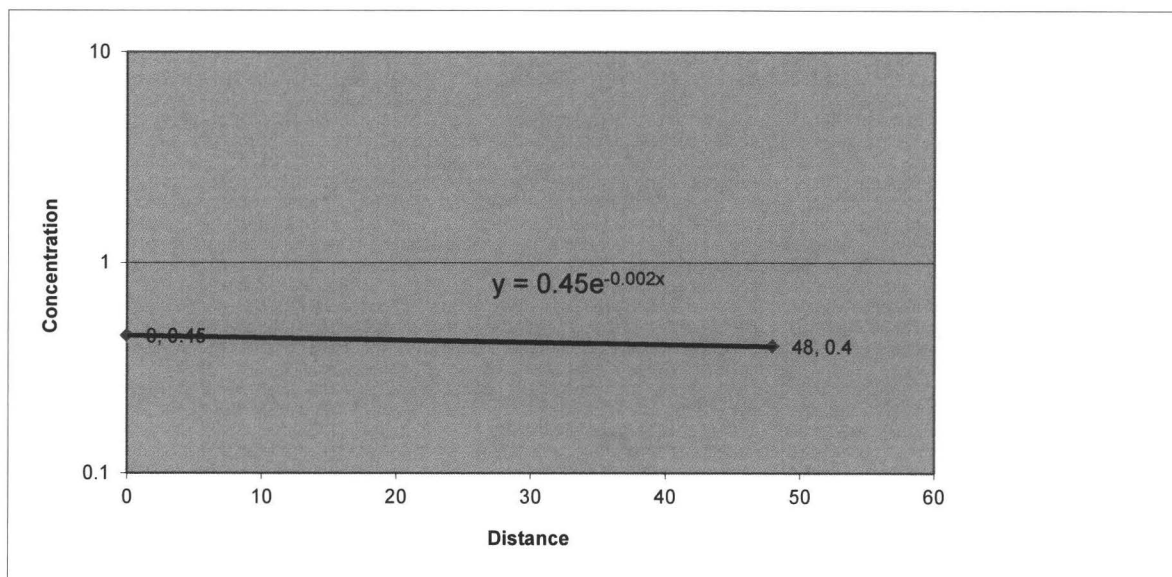
- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- J - Concentration is estimated or detected below RL
- CL - Centerline
- The higher result of MW-13 and MW-13 Dup was used

BULK ATTENUATION RATE CALCULATION FOR VINYL CHLORIDE IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A (source)	0	0.45	J
MW-13A	48	0.4	RL
MW-23A	176	0.4	RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.002	0.015	0.0000	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
2	NA	NA
10	NA	NA



Notes:

k - Concentration vs. Distance rate constant

Seepage Velocity - calculated from June 2012 water levels

Retardation Factor - assumed to be 1 to be conservative

RL - Reporting Limit

NA - Not applicable, calculated concentration level less than MCL

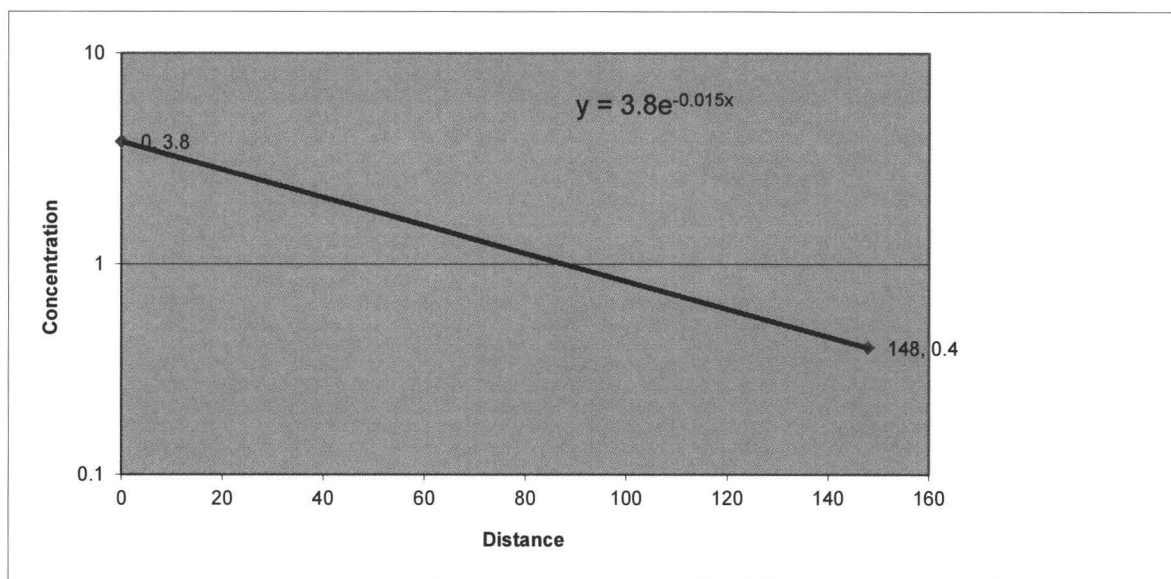
BULK ATTENUATION RATE CALCULATION FOR VINYL CHLORIDE IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)
MW-10	NA	1.3
MW-13 (source)	0	3.8
MW-23B	148	0.4

RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.015	0.012	0.0002	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
2	42.79	147.19
10	NA	NA
100	NA	NA



Notes:

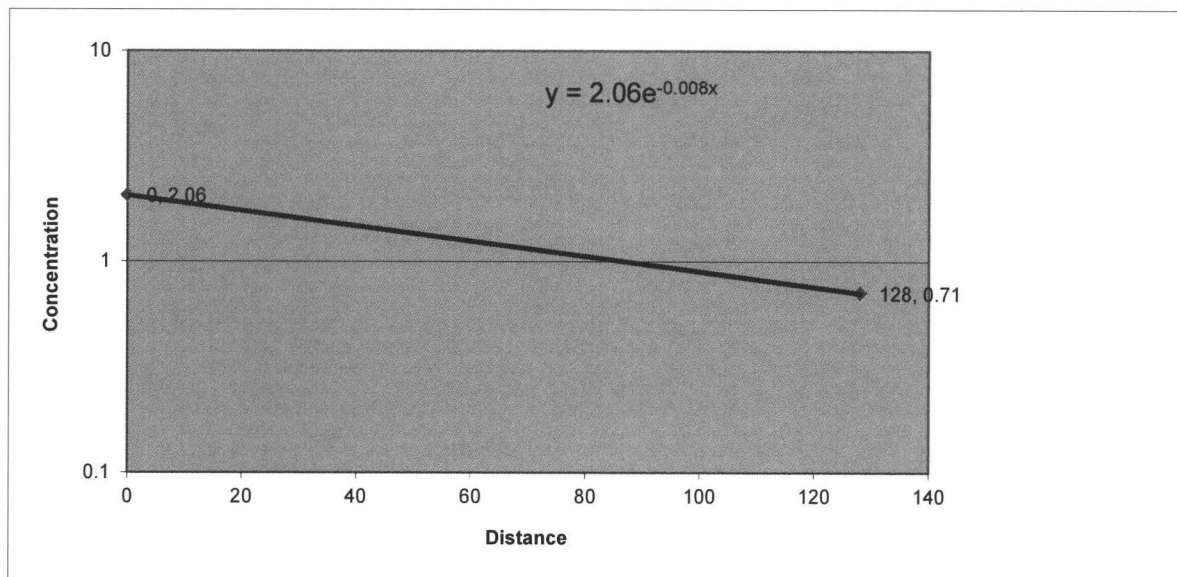
- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- NA - Not applicable
- CL - Centerline
- The higher result of MW-13 and MW-13 Dup was used

BULK ATTENUATION RATE CALCULATION FOR BTEX IN PLUME FILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10A	NA	0.71	All NDs, used Xylene RL
MW-13A (source)	0	2.06	Benzene (1.7) and Toluene (0.36) only dete
MW-23A	128	0.71	All NDs, used Xylene RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.008	0.015	0.0001	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	NA	NA
10	NA	NA
100	NA	NA
1000	NA	NA



Notes:

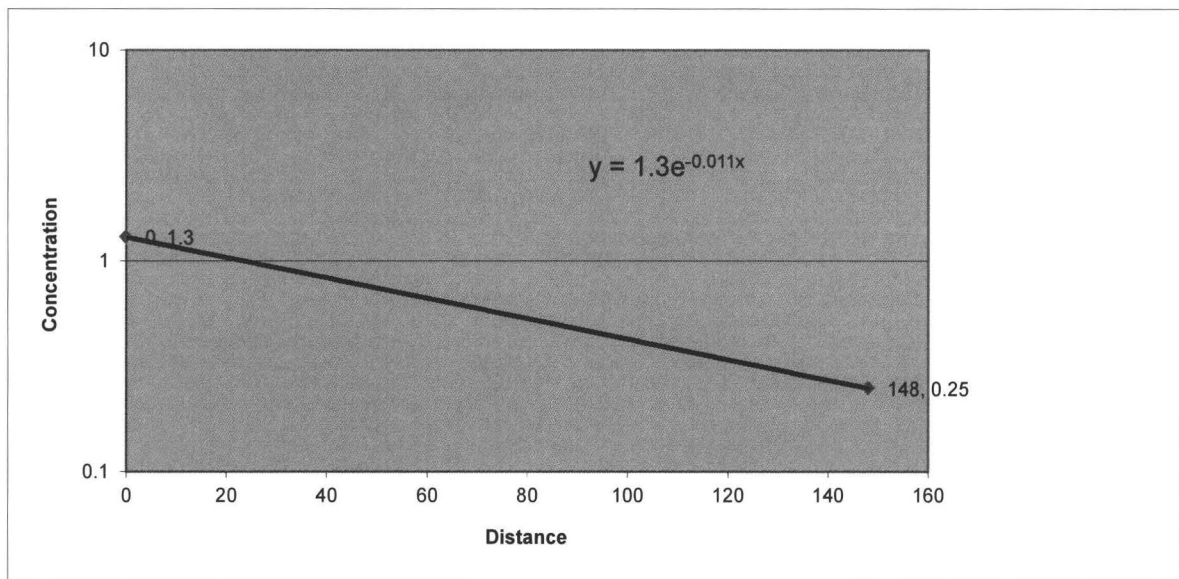
- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- NA - Not applicable
- CL - Centerline

BULK ATTENUATION RATE CALCULATION FOR BTEX IN PLUME TILL WELLS

Monitoring Well	Feet from Source	(ug/L)	
MW-10	NA	0.31	Benzene (.31) only detects
MW-13 (source)	0	1.3	All NDs, used benzene RL
MW-23B	148	0.25	All NDs, used benzene RL

Slope	Seepage Velocity (Feet per Day)	k	Retardation Factor
0.013	0.012	0.0002	1

Contour Interval (ug/L)	Distance from Source (Feet)	Distance along plume CL (from zero point)
5	NA	NA
10	NA	NA



Notes:

- k - Concentration vs. Distance rate constant
- Seepage Velocity - calculated from June 2012 water levels
- Retardation Factor - assumed to be 1 to be conservative
- RL - Reporting Limit
- NA - Not applicable
- CL - Centerline